Gilbert Walker: A pioneer of modern day climatology

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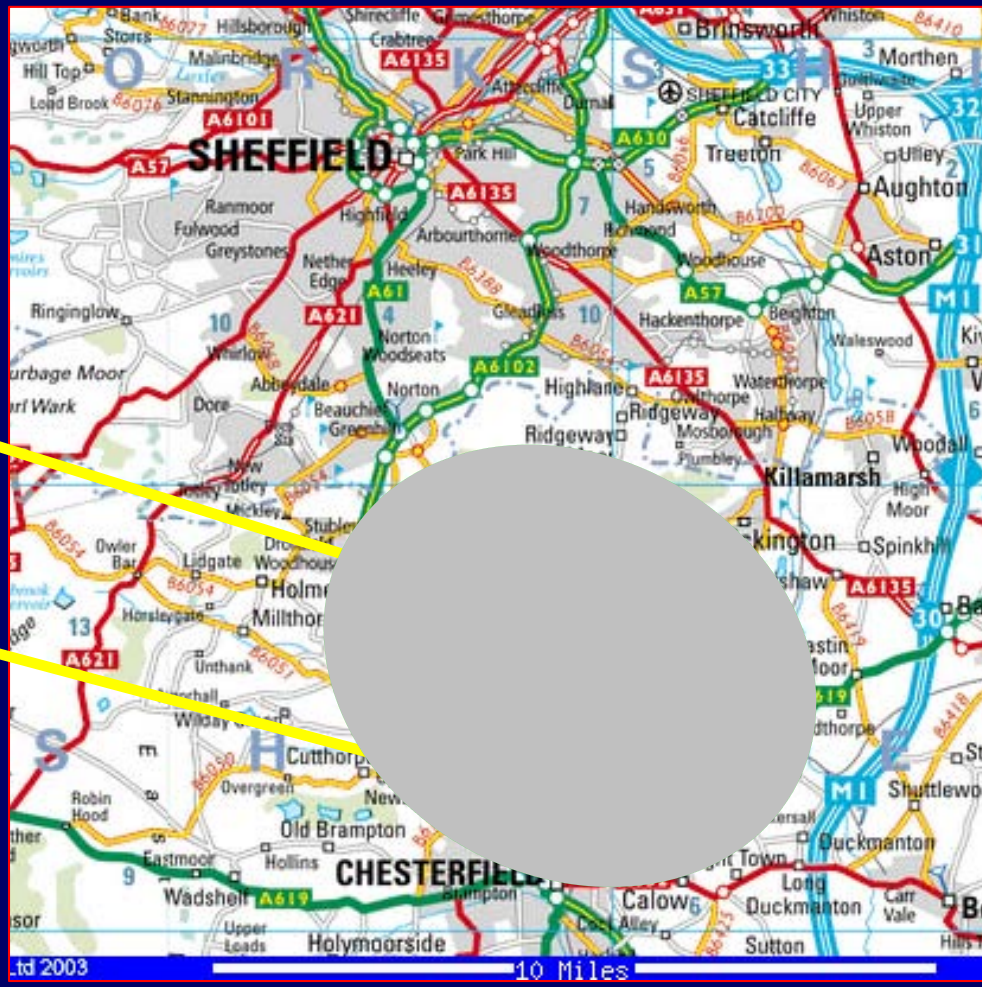
Sir Gilbert Thomas Walker 1868-1958

FAMILY BACKGROUND

- The world of Gilbert s forebears was very much focused on local issues and rural occupations up until his father s lifetime
- His father, Thomas H Walker, was born into a farming family on the 1/11/1833 at Unstone, Derbyshire
- His mother, Charlotte Elizabeth Haslehurst, was born at Newbold, Derbyshire in 1840
- Like the Walker s, the Haslehurst s had been farmers, millers and agricultural labourers in the same general part of Derbyshire since at least the 1600s



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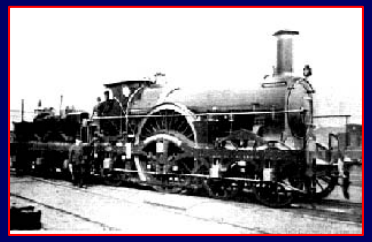
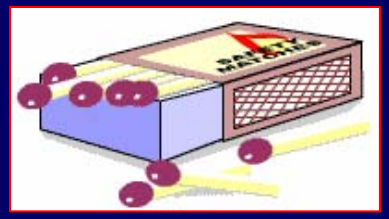
1830s-40s: IT WAS A RAPIDLY CHANGING WORLD

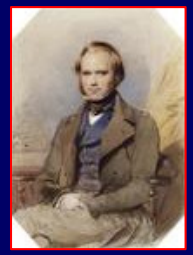
- Viable passenger train services were just becoming wide spread



- Friction lights or safety matches were a relatively new concept



- Charles Darwin was on his fateful world voyage aboard HMS Beagle



- The SS Great Western became the first steamship to offer regular passage across the Atlantic Ocean in 1838

- In 1841 Sir Joseph Whitworth devised the first standardised system for screw threads

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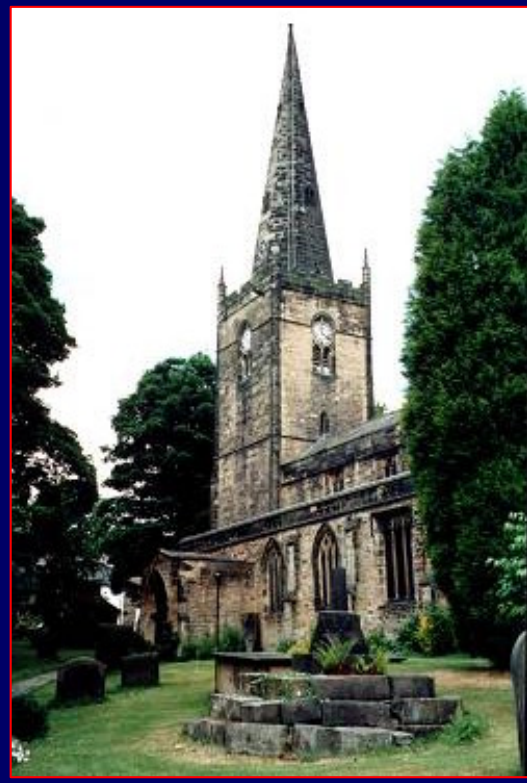
Thomas Walker and Charlotte Haslehurst

- One of Thomas s earliest memories was hearing cannon fired in Sheffield for the repeal of the Corn Laws in 1839
- 1844 to 1848, went to Chesterfield School (Bowkers) and in 1849 was apprenticed to John Richardson, Mining Engineer and Surveyor of Chesterfield for the next 4-5 years
- 1853 to 1859, he was an Assistant to Messers Mills and Fletcher of Birkenhead, Liverpool and was engaged with numerous surveys for capital projects such as waterworks and railways
- 1859 to 1862, he worked on contracts for the Mersey Docks and Harbour Board with the Dock Engineer at Liverpool
- Charlotte Haslehurst was sent to boarding school when she was six years old
- One of her earliest memories was of the funeral of the engineer and train pioneer George Stephenson in 1848



Dronfield Parish Church where many generations of Walker ancestors are buried

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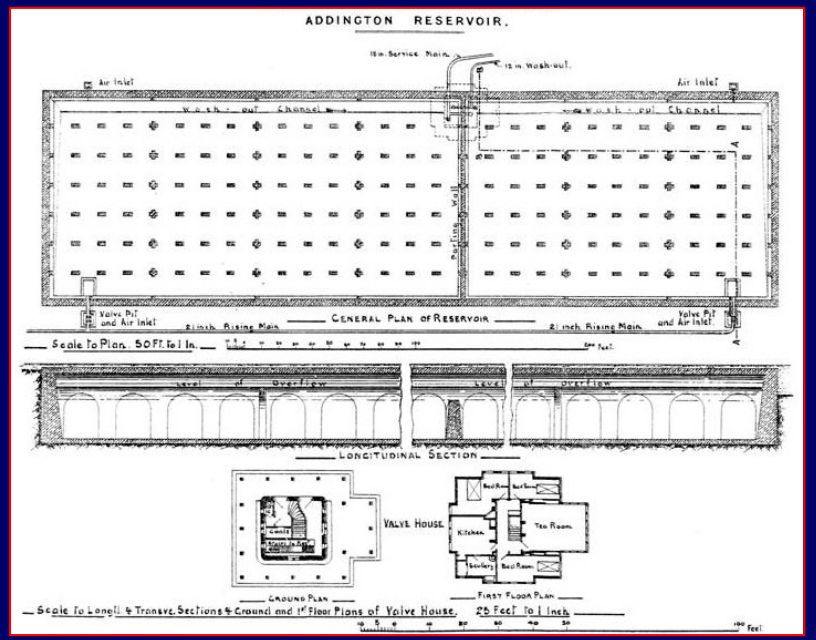
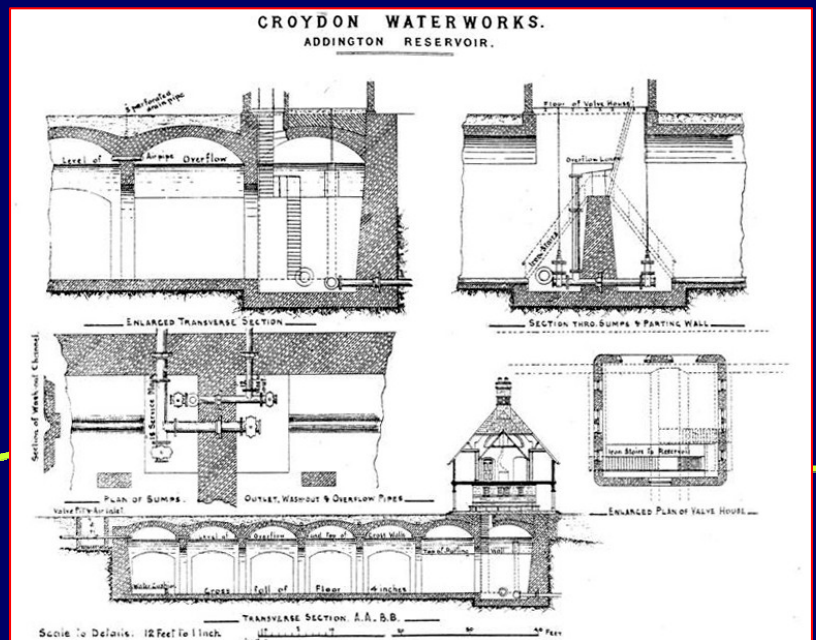
Gilbert Walker: Early Years

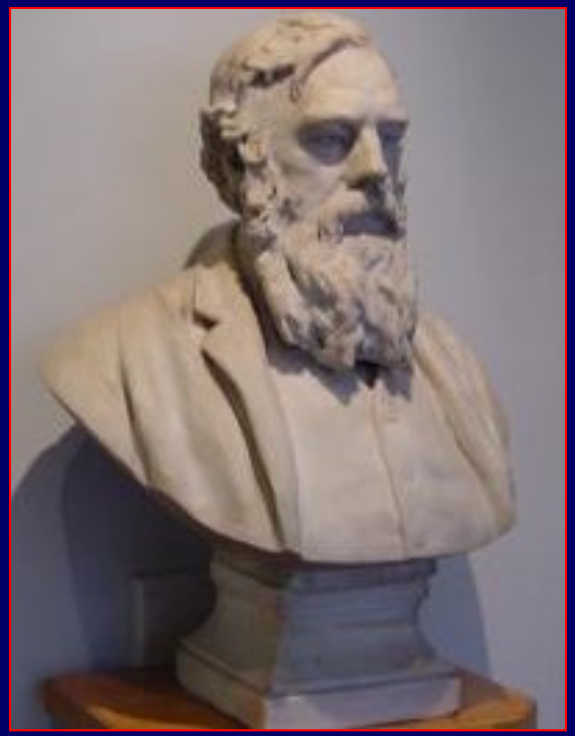
- **Thomas Walker and Charlotte Haslehurst, who were first cousins, were married in 1862**
- **Between August 1865 to December 1870, Thomas was Borough Surveyor of Rochdale**
- **Gilbert Thomas Walker was born at Rochdale, Lancashire, 14/6/1868 (4th of 7 or 8 children)**
- **In 1871, the Walker family moved from Rochdale to South Croydon when Thomas was appointed as the Borough Engineer and Surveyor to the Croydon Local Board of Health**
- **In 1888, Thomas was responsible for the construction of Addington Reservoir where he pioneered the use of concrete in dams (Though abandoned in1923, the reservoir was used temporarily in the Second World War as an emergency water supply for fire fighting purposes)**





School Days

1876-1881: Whitgift School, South Croydon
1881-1886: St Paul s School, West Kensington



Frederick William Walker (no relation)
High Master at St Paul s School, West Kensington during Walker s time

St Paul s School, West Kensington, July 1886

My dear High Master,

As Walker is now leaving school for the University, this is the last time that it will be my duty to report to you on his progress and on the quality of his work. Throughout the time that he has spent with me his work has been so uniformly good, and he has been as persistent and untiring in his devotion to it, that I can scarcely speak too highly of him.

It is a matter for special regret that his illness during the examination should have taken from him his last and best opportunity at school of displaying fully his mathematical knowledge and power.

I have never parted from any of my boys with more respect and confidence that I now do for him and I hope that his health will allow his career at the University to be a harmonious continuation of his career at St Paul s.

I am very faithfully yours,

C. Pendlebury.

[Charles Pendlebury, a well known writer of school arithmetic texts, was senior mathematical master at St Paul s School during the late 19C]

In all this I fully concur and find it hard to drive from my thoughts the sad intelligence of his serious illness. Fred W. Walker

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Trinity College, Cambridge

Dr Hugh Hunt, Senior Lecturer, Dept of Engineering, Trinity College, throwing boomerangs on The Backs at Trinity College

Matriculated, London University (Honours with Exhibition), July 1884

Trinity College (Minor School) 1884

Trinity College (Major School) 1885

Smee Prize (essay on gyroscopes) 1885

Undergraduate at Trinity October 1886

Thomas Barnes Scholar 1887

Sheepshanks Scholar (Astronomical) Exhibition 1887

B.A. (Senior Wrangler) 1889

First Class (First Division) Mathematics Tripos Pt II June 1890

London University, B.Sc. Examination (Honours and Mathematics Scholarship) November 1890

Smith s Prize 1891

Fellow of Trinity 1891

Health problems led to Gilbert spending the 1891-1893 winters in Switzerland, where his passions for ice skating and climbing grew

MA 1893

During his time at Cambridge, Gilbert developed an interest in projectiles, ball games, sinning tops, flight and throwing sticks especially boomerangs which he threw on The Backs at Trinity College his nickname was Boomerang Walker

Mathematics Lectureship 1895-1901

Adams Prize (paper on electromagnetic fields) 1899/1900

The Indian Meteorological Department (IMD)

Henry Francis Blanford, 1st British Director (Imperial Meteorological Reporter) of the IMD (1875-1889)

The Indian Meteorological Department (IMD) was **founded in September 1875**, and based originally in Calcutta

The 1st IMD Director, Henry Blanford, examined climatic conditions over the Indian subcontinent in an **attempt to forecast the monsoon**

Following **severe monsoon failure** and extreme high atmospheric pressure readings **over India in 1877**, Blanford requested meteorological services and observatories around the Indian Ocean, Asian to Australasian regions to provide the IMD with their observations of atmospheric pressure and general climatic conditions

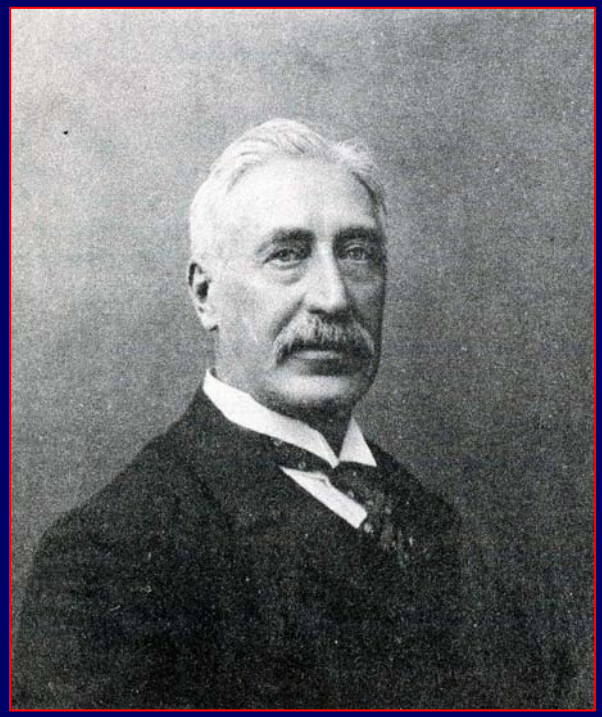
Blanford found that a **pattern of abnormally high pressures** had extended to western Siberia, northern China and southern Australia during 1877 (we now know that the 1876-1877 El Niño was one of the strongest in the last 200 years)

In 1881, Blanford looked at possible links between the **solar cycle and Indian monsoon rainfall** as suggested by Sir Norman Lockyer

By 1882, he started to examine monthly reports of **Himalayan snowfall as a possible monsoon precursor**

Between 1881 and 1884, Blanford used snowfall, wind and pressure observations over India in **experimental monsoon forecasts** these were never issued

From 1885/1886 the IMD began publishing **regular forecasts of Indian monsoon rainfall** using previous January-May snowfall over the Himalayas and regional climatic patterns



Sir John Eliot,
2nd British Director (Director-General of Observatories) of the IMD (1887-1903)

John Eliot, the 2nd Director of the IMD **expanded Blanford s forecasting** efforts by examining past analogues of climatic conditions over India and widening the scope of precursors used in each forecast to include:

(a) **variations in the trade winds over the Indian Ocean**
(b) **strength of the South Indian Ocean anticyclone**
(c) **Nile floods**
(d) **data from southern Australia and South Africa**

From around 1892, monsoon rainfall **forecasts began to deteriorate** in accuracy as it was observed that previous relationships involving Himalayan snowfall and Asian-Indian climatic patterns had changed

Indian **newspaper criticisms** of Eliot s failed forecasts from 1899-1901 led to the monsoon forecasts from 1902 to 1905 being made **confidentially to the Indian Government**

Rekindled interest in the **solar-weather relationships** advocated by Sir Norman Lockyer and his son William, and claims of new links between sunspots and rainfall in countries around the Indian Ocean, led Eliot to meet with the Lockyers and the Astronomer Royal near Bombay during the eclipse of 1898

As his term of office drew to a close, Eliot was on the lookout for a **successor with strong statistical/mathematical qualifications** who could assess the variously suggested links and relationships with Indian monsoon rainfall

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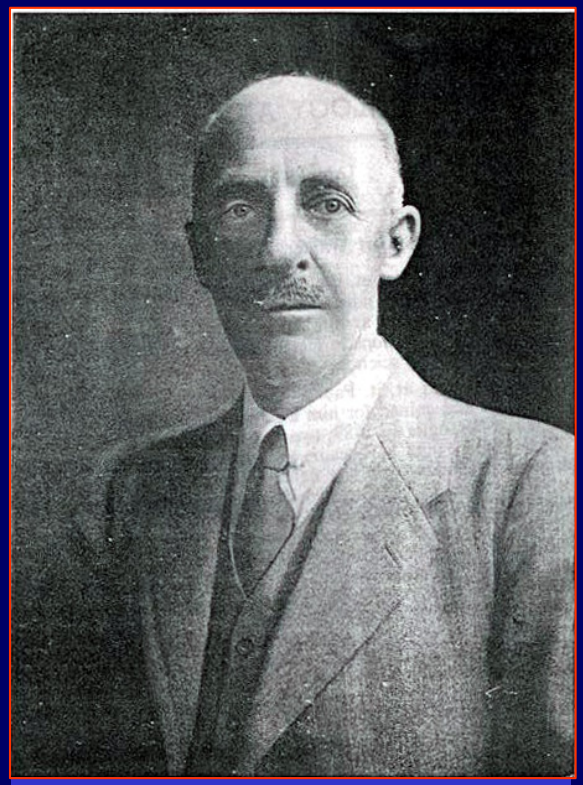
Learning the ropes



Sir Gilbert Thomas Walker, 3rd British Director (Director General of Observatories) (1904-1924)

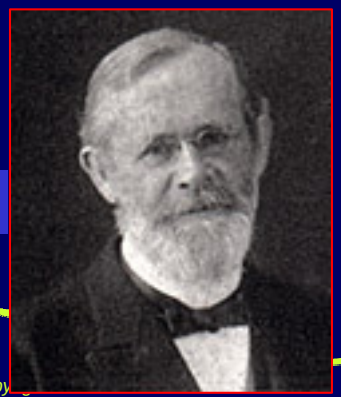
Around 1901, and at least on the advice of the Observatories Committee of the Royal Society, John Eliot looked to **Gilbert Walker as his successor**

Gilbert Walker had no training in meteorology or climatology and had been applying for various positions, including the Chair of Natural Philosophy at the University of Edinburgh - Lord Kelvin had offered his support in Gilbert s application for the latter

As a way of gaining some measure of understanding of the post he was taking on, Gilbert **visited meteorological services** and offices in the UK, USA, France and Germany during 1902-1903

In the US he visited not only the Weather Bureau but many observatories, and from his correspondence had obviously endeared himself to many he met with his **expertise in all aspects of boomerangs**

He also developed a close friendship with Cleveland Abbe, the founding Director and Head of the Weather Bureau. Abbe, who had begun his professional career studying the stars , had become America's first, and best known, weather forecaster. Many consider him the **true father of the US Weather Bureau** where he spent his long career as meteorologist-in-charge from its establishment until his death in 1916 at the age of 78. Even Mark Twain called him "Old Probabilities" in recognition of his fame as a weather prognosticator.



Cleveland Abbe

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In Charge

Simla in the 1880s-1890s

For much of 1903, Walker was a **special scientific assistant** to Eliot gathering his own experience and making links to other meteorological services and observatories he arrived in India late in that year

On the 1st of January 1904, Gilbert took up his post as **Director General of Observatories in India**

He was awarded a Sc. D. at Cambridge in 1904 and quickly gained the trappings of the post, being elected a **Fellow of the Royal Society** (1904), a **Fellow of the Royal Meteorological Society** (1905), and a **Fellow of the Royal Aeronautical Society**

During Eliot s tenure, the IMD moved between Calcutta in winter and Simla in summer at Simla the IMD was located in a rented part of Eliot s summer home of Constancia **Walker settled the IMD head office in Simla**

Simla today

Met Office

Walker in Simla

Playing fields at Annandale, Simla

Gilbert Walker had the perfect environment in which to develop and enjoy his wider interests

- bird flight (later wrote papers on aerodynamics of flight)
- throwing boomerangs on the playing fields at Annandale (he had written definitive papers on them)
- climbing and walking in the hills around Simla
- painting (showed water colours at the Simla Art Exhibition)
- ice skating
- flute playing (theory, practise and evolution)

but also a heavy administrative burden

The great change from the academic life in Cambridge to that of an official responsible for the organisation of the Indian observatories and weather service must have absorbed most of Walker s energy, for he published no scientific papers in the years between 1903 and 1909 (Taylor, 1962).

Marriage Solemnized at St James Church in the Parish of St James in the County of Southampton

No.	When Married.	Name and Surname.	Age.	Condition.	Rank or Profession.	Residence at the Time of Marriage.	Father's Name and Surname.	Rank or Profession of Father.
93	May 13 1908	Gilbert Thomas Walker	39	Bachelor	Director Govt Observatories India	Hill Station Hotel	Thomas Walker	Esquire
		May Constance Carter	31	Spinster		Maidenhead Berks	Charles Stephens Carter	Esquire

Married in the St James Church according to the Rites and Ceremonies of the Established Church by Licence or after By me,

This Marriage was solemnized between us Gilbert Thomas Walker, May Constance Carter. In the presence of us, Samuel Reuben Whitby, Margaret Edith Ready

The above is a true Copy of the Marriage Register of the aforesaid, the said Register being legally in my custody.

Extracted this Thirteen th day of May in the Year of our Lord One Thousand nine Hundred and eight

By me,

ONE PENNY

Marriage Certificate of

Gilbert Walker and May Constance Carter

St James Parish Church, Southampton 13th May 1908

Walker and the IMD

When Walker started work he realised at once that there was little scientific basis for the production of seasonal forecasts (Taylor, 1962)

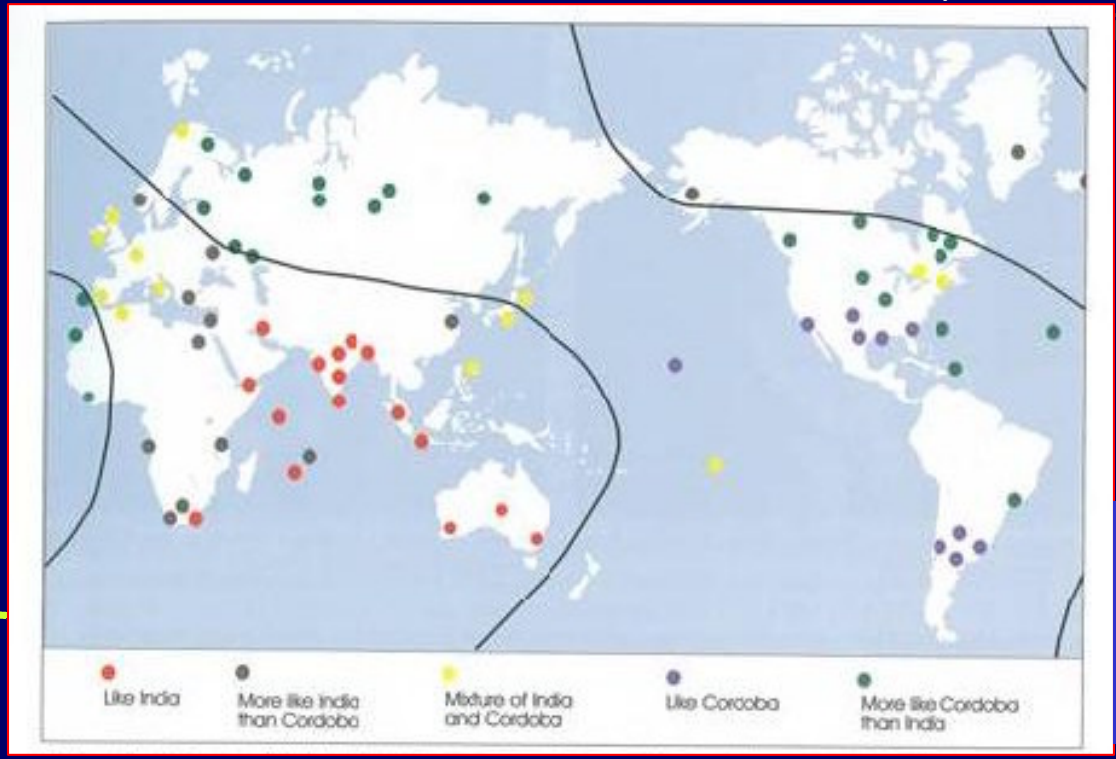
He decided that since he saw no prospect of treating the weather as a subject to which mathematical reasoning from well established premises could be applied [at the time], he would collect all the relevant information which had been recorded and treat it statistically without attempting to trace physical connexions between cause and effect (Taylor, 1962)

He initially had three assistants (J Field, John Patterson and George Simpson later Directors of meteorological services in India, Canada and Britain) to help him in these endeavours e.g. examine all telegraphic reports

Given the nature and extent of the Indian monsoon, Walker soon found that he had to examine ime delays (leads and lags)

Walker s first forecast of Indian monsoon rainfall in 1909 using a regression equation

All-India Monsoon Rainfall = -0.2[Himalayan snowfall accumulation] -0.29[Mauritius pressure] +0.28[mean of South American pressure] -0.12[Zanzibar rainfall]



Distribution of stations that display varying associations with atmospheric pressure fluctuations in India and at Cordoba in South America (after Lockyer and Lockyer, 1904)

Swings and Roundabouts

Early stability and workable staff numbers suffered with *the departure of Dr Simpson on Scott s Polar Expedition in 1910 and the subsequent resignation of Mr Patterson, followed by illness among the remaining officers , led in a period when routine work was with difficult kept up to date and research work became impossible* (Meteorological Office, India, 1925)

Scientific papers 1910-1915:

that the turn-of-the-century **changes in Indian climate** were due to natural variations in the climate system and not anthropogenic influences

correlations between **sunspots and rainfall, temperature and pressure**

relationships with **Indian monsoon rainfall**

Indian meteorological network and practices:

set up the **network of upper air observatories** across India

expanded and improved **meteorological services for shipping**

improved the **solar observatory** at Kodiakanal (under Jack Evershed)

an **experimental meteorological laboratory** and workshop was set up

Acknowledgements:

Companion of the Order of the Star of India (CSI), 1911

No sooner had the staff settled down to the new regime than the Great War called for officers, and the years 1916 to 1919 formed a period in which part of the routine work e.g., the preparation of Monthly Weather Reviews and Annual Summaries, as well as the examination and compilation of upper air results, had to be allowed to fall into arrears (Meteorological Office, India, 1925)

Met Office

Family and Health and the IMD

Verity Micheline Walker was born in 1910

Gilbert Walker s health suffered from the strain of running the IMD with its continual shortfalls and fluctuations in accommodation, finances and staff. The absence of George Simpson on Robert Scott s Polar Expedition from March 1909 for 3 years was particularly felt Gilbert had worked hard to secure Simpson for the IMD. In May 1912, in a letter to Walker, Simpson writes *I cannot express to you my deep concern when I heard in the South of your breakdown, and Field will no doubt have told you that my leaving the Expedition was due to my wish to help in every way I can to remedy a state of affairs, for which I feel I am largely responsible* In IMD official documentation, Walker is noted as being away in Europe on a combination of privilege and medical leave from July 1911 until April 1912

Michael Walker was born in 1917

Gilbert Walker with son Michael in England

Human computer and home

During the First World War, with mainly an Indian staff to draw on, ***the only attempt at scientific work at this time was the engagement of part of the clerical staff on a programme of computation, which Sir Gilbert Walker was later able to utilise in a series of important papers*** (Meteorological Office, India, 1925)

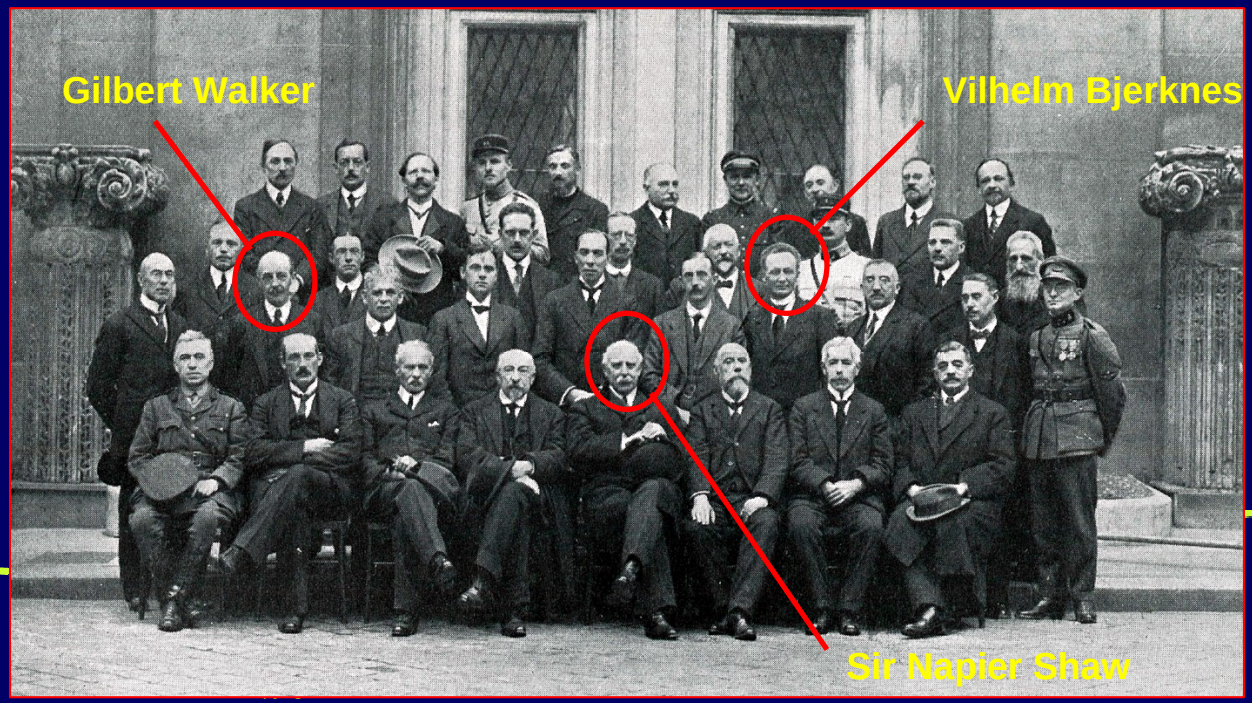
Walker s Indian staff were charged with performing a mass of statistical correlation studies (simultaneous plus leads and lags) using all the meteorological and hydrological data from around the world that was available forming basically a **human computer**

He was the President, and gave the Presidential address to the Indian Science Congress in 1918

President of the Asiatic Society of Bengal in 1918

Attended the International Meteorological Conference in Paris in 1919 representing India

Received a Ph.D. (Honorary) from Calcutta University in 1922



Delegates at the International Meteorological Conference in Paris in 1919

Home, Imperial College and Oscillations

Gilbert Walker completed his tenure as Director General of Observatories in India in December 1923 and returned to England in the following year

He was knighted on the 3rd of June 1924 in King s Birthday Honours while still in India

Walker was appointed Professor of Mathematics at the Imperial College of Science and Technology in September 1924, succeeded Sir Napier Shaw (4th Director of the Met Office) Walker held the post until September 1934 when he retired

Though undertaking a number of applied meteorological studies, including investigations into the formation of clouds, it was in a series of papers authored by himself and Edward Bliss on global climatic fluctuations, that Gilbert Walker presented the scientific findings for which he is most remembered

This research would not have been possible without the masses or correlations amongst climatic variables worldwide that were produced during his time in India he was essentially a pioneer of the use of correlations in meteorology/climatology

Walker *contributed also to the theory of correlation in that he established a criterion of significance for use when the highest of a large number of correlation coefficients are chosen* (Normand, 1959)

This development of statistical methods and his collection and study of the meteorological records from all parts of the world, will make Walker s name famous to all those engaged in the important study of seasonal weather forecasting (Sir George Simpson, 1959 5th Director of the Met Office)

Yet, contrary to what some have believe since, Walker *was always on the lookout for the physical causes behind relationships* (Normand, 1959)

In 1924, in one of Walker s papers under the title of World Weather, science was first introduced to the terms Southern Oscillation, North Atlantic Oscillation, and North Pacific Oscillation

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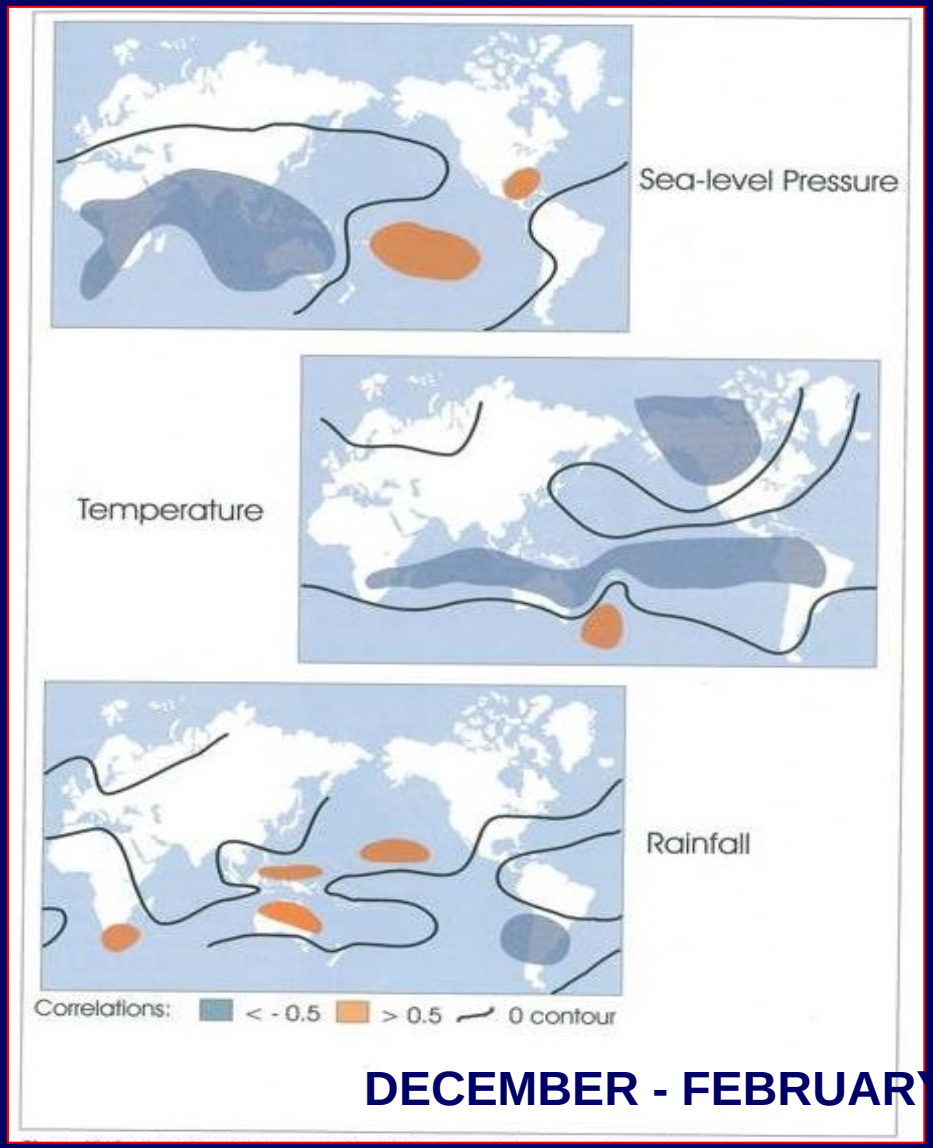
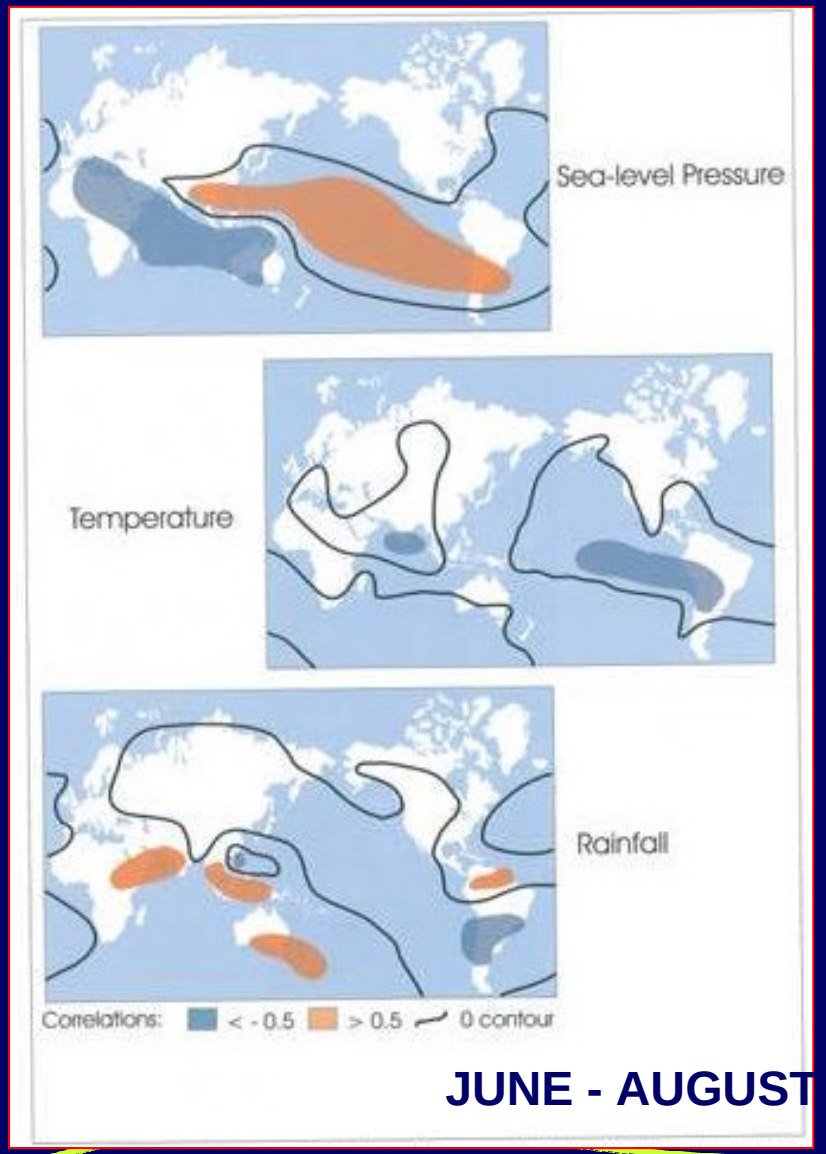
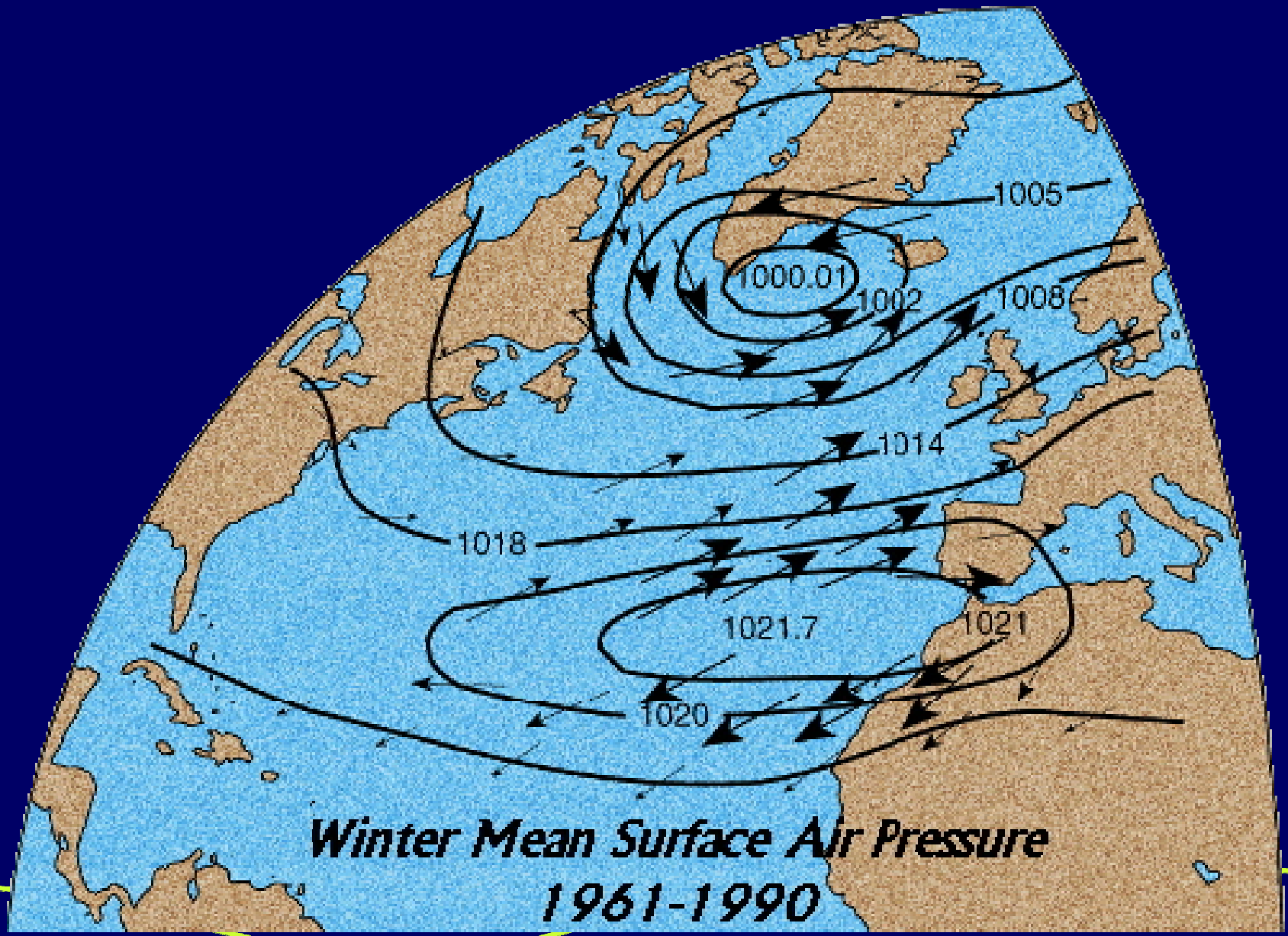
Walker s Southern Oscillation





Walker s Southern Oscillation Index (SOI) correlated with contemporary sea level pressure (top panels),
Temperature (middle panels) and rainfall (bottom panels) (after Walker and Bliss, 1932)

Walker s North Atlantic Oscillation



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Honours and service

Sir Gilbert Walker
RMS Symons Gold Medallist 1934

Vice President of the Royal Meteorological Society (RMS) in 1923, 1924 and 1928

Member of the RMS Council in 1925

President of the RMS in 1926 and 1927

Member of the International Commission for the Investigation of the Upper Air in 1925

Attended the Meeting of British and South African Associations in South Africa in 1929

Confirmed with the title Professor of Meteorology in the University of London in 1930

President of Section A of the British Association in 1933

RMS Symons Gold Medalist in 1934

Royal Aeronautical Society (RAS) Simms Gold Medalist in 1934

Member of RMS Council from 1935 to 1939

Editor of the Quarterly Journal of the RMS from 1934/5 to 1941

Delegates at the International Commission for the Investigation of the Upper Air in 1925

Met Office

The influence of Walker s work on long-range forecasting

GIRLS AID RESEARCH IN WEATHER PROBLEMS

Recent Discovery May Lead to Long-Range Forecasts

Mr. K. N. S. Hall and Misses Joyce Partridge and Joan Darby, who are carrying out the research work.

OUT of a mass of figures and records that go back 45 years two Brisbane girls, whose blonde attractiveness almost belies their interest in the prosaic study, have made what seems an important discovery.

They have found that in Southern Queensland, from Dalby to Goondiwindi, the summer rainfall appears to be largely controlled by conditions of the previous winter over areas of the Pacific and Indian Oceans. Even floods in the Nile enter into the calculations.

From this Mr. Travis Rimmer, M.Sc., lecturer in meteorology and physics in the Queensland University, who is directing meteorological research work there, hopes that ultimately forecasts of summer rainfall for the various districts of the State may be made at the end of the preceding winter.

The girls, Miss Joyce Partridge, a 20-year-old University student, and Miss Joan Darby, who is nearly 16, are computers in the research being made under a grant from the Council for Scientific and Industrial Research. With Mr. Rimmer also is Mr. K. N. S. Hall, B.Sc., a master at the Brisbane Grammar School, who has obtained leave for the work.

The work of the girls has been to examine data from a number of meteorological stations, prepare graphs, and compare them. They thus found that an abnormally wet or dry winter over the Pacific and Indian Oceans areas was in most cases followed by an unusually wet or dry summer, respectively, in Southern Queensland.

To the girls Mr. Rimmer gives credit for the "interesting discovery." He, however, has done much mathematical calculation from it to work out a formula for the Southern Queensland area based on deviations of pressure in South America, Honolulu, Batavia, and Cairo, the state of the Nile floods each year, and temperatures in India.

He said yesterday the formula must yet be modified for data more easily accessible. The research, which began only about April, had shown the oscillation between movements of air masses in the Pacific and Indian Oceans.

For Whole State

They were now trying to adapt the formula to give one for each rainfall district of the State. If the principle was definitely established, data could be obtained at the end of August each year to forecast whether the following summer would have excessive rain and floods or deficient rainfall, or would be about normal.

In the southern area, for example, such a forecast would cover Darling Downs wheat farmers, who might be advised to plant other crops suitable to the anticipated rain. In other districts graziers might be saved losses by advising them to move sheep or cattle.

Mr. Hall, he said, was working out a classification of the types of rainfall in various districts from records over 12 years. When completed his survey would be a very valuable guide where to look for control stations for data. Work of this kind had never been done here before.

Mr. Rimmer said that in all the research the Weather Bureau was giving valuable co-operation. If some basis of long-range forecasting could be established, it should be left to the Bureau to carry it out.

The Courier-Mail, Brisbane, 8th of September 1937

A number of papers from researchers in many countries appeared in the scientific literature during, and immediately after, Walker s time which **built on his research into long-range forecasting** (foreshadowing, as Walker termed it)

Particular **emphasis was on the Southern Oscillation** and its influence

Mossman (1923) **South American** climate

Tu (1936, 1937) **Chinese** rainfall (floods and droughts) and temperature

Maung Po (1942) - **Burmese** rainfall

Berlage (1927, 1934) **Dutch East Indies (Indonesia)** monsoon

Bliss (1930, 1936) **Caribbean** rainfall

Kidson (1925), Quayle (1929) - periodicities in **Australian** climate and rainfall

Rimmer and Hossack (1939) **Queensland** rainfall, Australia

However, a combination of circumstances led to a **decline in research on the Southern Oscillation during the 1940s-1960s period**

There were **criticisms of Walker s statistical methods**, concerns at the **lack of physical mechanisms** underpinning the Oscillations, a rapid growth in works trying to **link his findings to lunar, solar and planetary influences**, and a **growing focus of weather forecasting** needs

More worrying, was that correlations and algorithms linking the **when data were**

Met Office

Later years

He supported and encouraged the sport of gliding in the UK

Was responsible for design changes in the flute

During the Second World War, Sir Gilbert Walker worked on research concerning long-range forecasting, and correlations amongst upper air data and European and Arctic weather under the Meteorological Research Committee of the Air Ministry

He was made an Honorary Fellow of Imperial College in 1946

Lived in Cambridge until 1950

His daughter Verity Micheline often accompanied him to Royal Society meetings

Honorary Member of the RMS from 1952

Still went to the Royal College of Music in his eighties to take flute lessons

He made and flew paper boomerangs for his grandchildren, and gave one grandchild a metal spinning top as a present

Sir Gilbert Thomas Walker died on the 4th of November 1958 at Woodcote Grove

He was a very normal human being, with none of the proverbial eccentricities of mathematicians among whom he ranked high. This normality itself is perhaps a great and likable distinction (Sohoni, 1959)

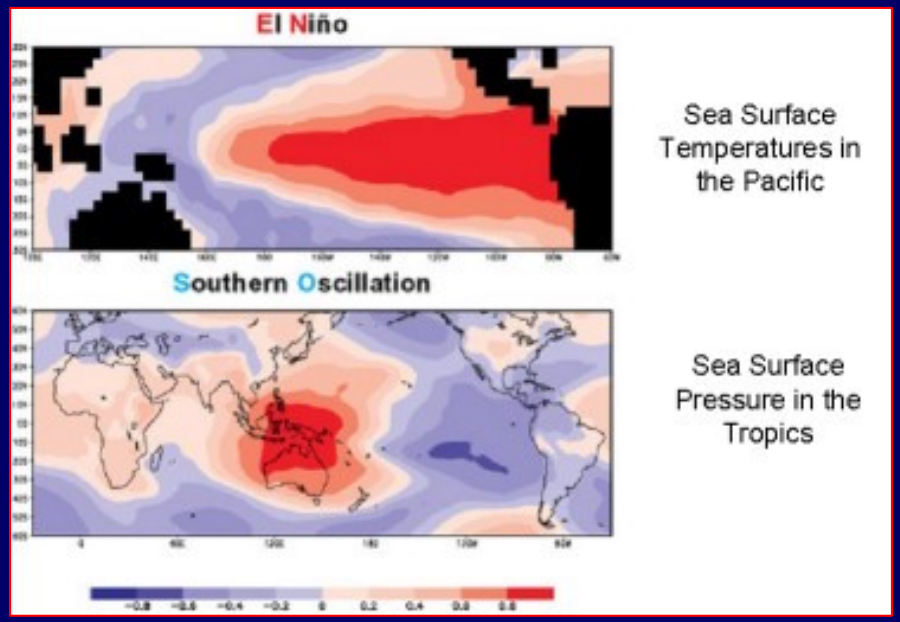
Legacy

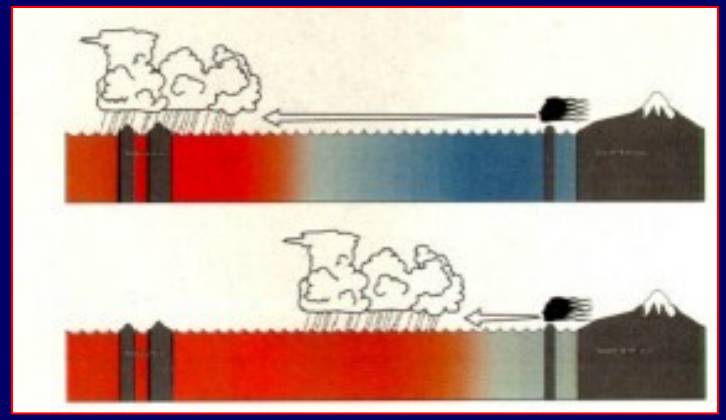
I think that the relationships of world weather are so complex that our only chance of explaining them is to accumulate the facts empirically; we know that it was impossible to explain cyclones (lows) until data of the upper air conditions were available, and there is a strong presumption that when we have data of pressure and temperature at 10 and 20 km, we shall find a number of new relations that are of vital importance

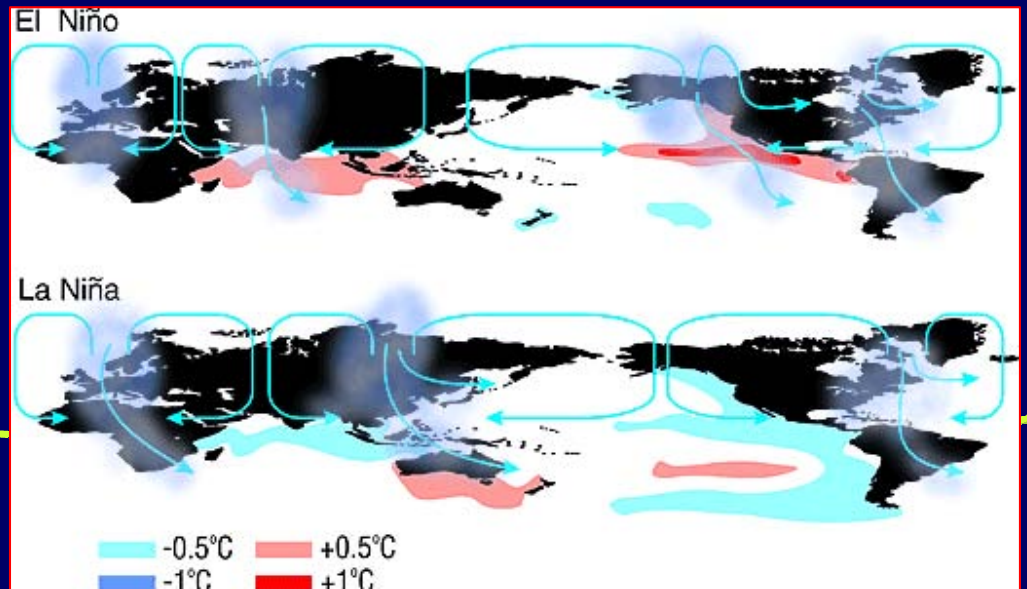
Sir Gilbert Thomas Walker 1932

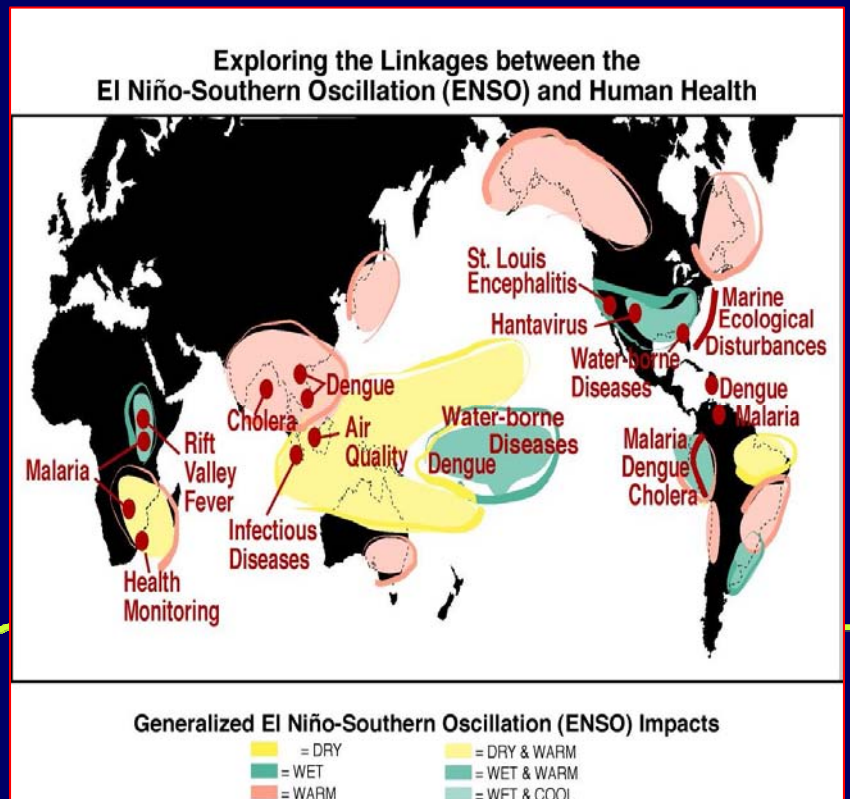
Met Office

El Nino Southern Oscillation (ENSO)
El Nino & La Nina

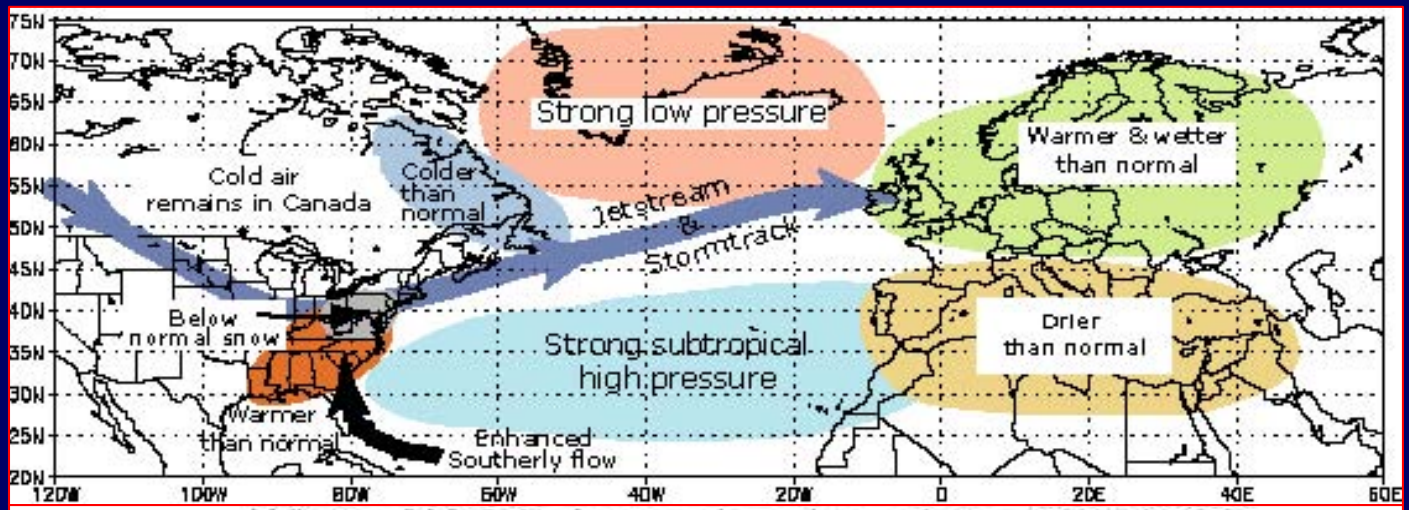


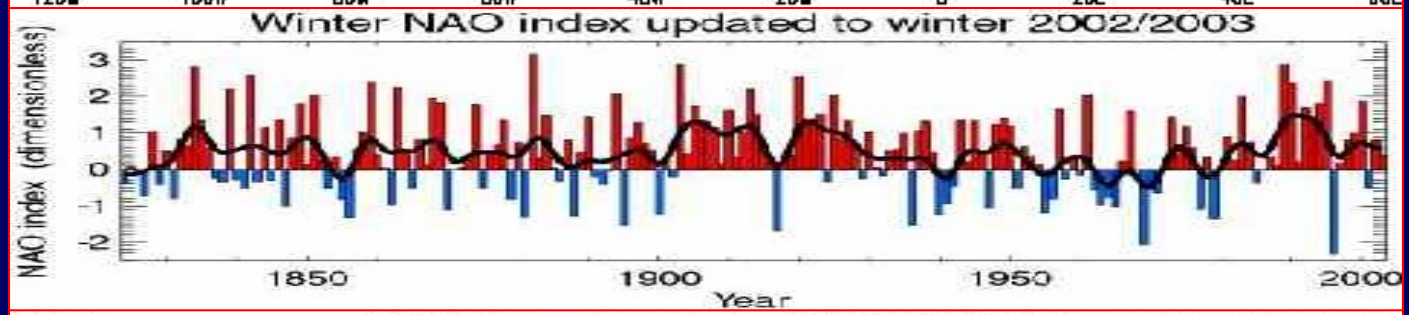


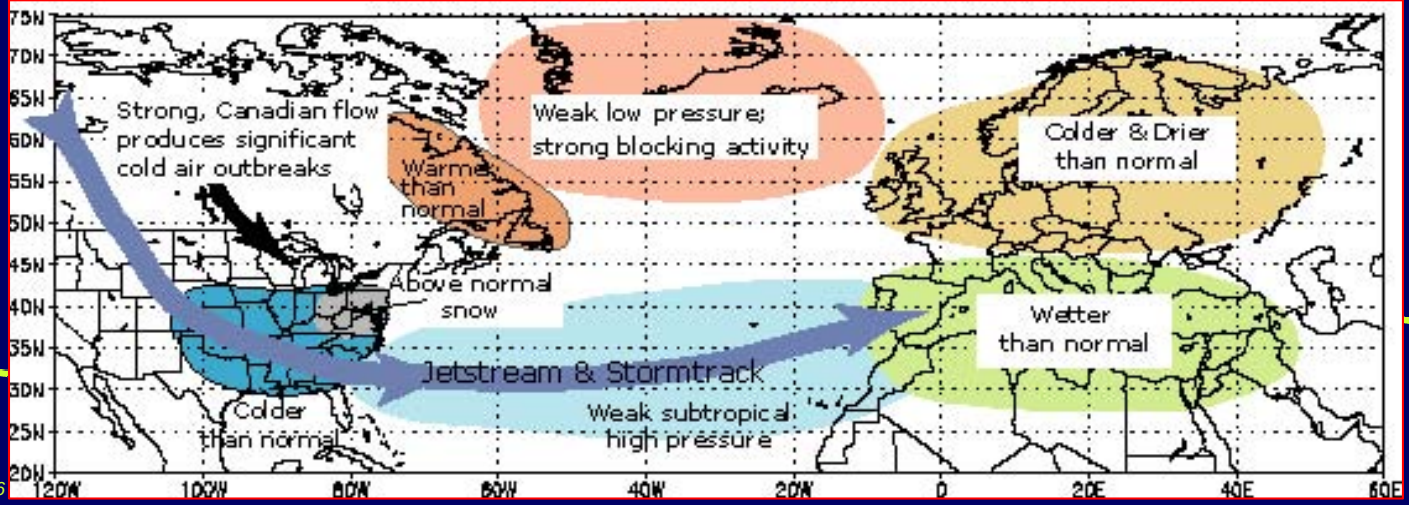




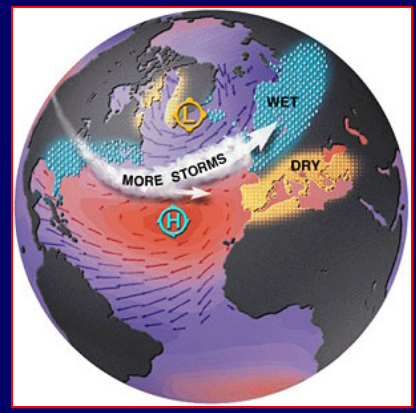
North Atlantic Oscillation (NAO)



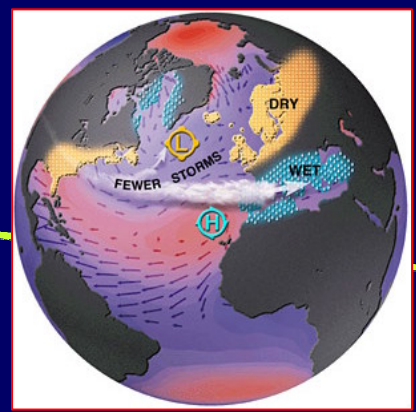




Positive Phase



Negative Phase



The Sir Gilbert Walker Gold Medal

The award has been instituted by the Indian Meteorological Society to be given biennially to an eminent Indian or foreign scientist of international recognition in the field of monsoon studies. The award is named after Sir Gilbert Walker who was a pioneer in the field of monsoon forecasting. He was the Director General of Observatories of Indian Meteorology Department from 1904 to 1924.

The first Sir Gilbert Walker Gold Medal was present in March 2001 to Professor Jagadish Shukla head of the Center for Ocean-Land-Atmosphere Studies and the School of Computational Science at George Mason University, USA.

Met Office