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# British Association for the Advancement of Science – Collections on the History of Science (1830s-1970s)

*inside the archive*

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BRITISH SCIENCE ASSOCIATION
IN PARTNERSHIP WITH Jisc

# Introduction

"Our vision is of a world where science is at the heart of culture and society"

***– British Science Association***

**Introduction to the British Association for the Advancement of Science—Collections on the History of Science (1830s-1970s) Archive**

The British Association for the Advancement of Science was founded in 1831. Its aim: to transform science from a self-funded endeavor of the wealthy into a government funded professional activity at the heart of social and economic development. This archive connects the works, thoughts and interactions of the most influential scientists of the time, from Darwin to Ramsay, and documents the history of British science from the 1830s through the 1970s across disciplines and universities.

The BAAS archive is complemented by a wealth of material drawn from leading British universities. Over ninety percent of the content within this unique archive has not been available digitally until now. The materials within the archive document 150 years of scientific discovery, Britain's emergence as a center for science, and provide an insider's perspective that is invaluable to researchers.

This look book provides a window into some of the stories that shaped modern science.

To learn more about these and other stories in The British Association for the Advancement of Science—Collections on the History of Science (1830s-1970s) archive, visit wileydigitalarchives.com/british-association-for-the-advancement-of-science.

# Professionalization of Science

CANADA IS HOST TO PARLIAMENT OF SCIENCE

Hon. Sir C. A. Parsons | Sir Ernest Rutherford | Sir David Bruce | Sir Robert Falconer | Sir Arthur Currie | Rt. Hon. Lord Bledisloe | Senator Marconi | Dr. J. C. McLennan

FAMOUS SCIENTISTS OF MANY COUNTRIES TO MEET IN TORONTO

Ninety-third Session of British Association for Advancement of Science to Be Attended by Many Distinguished Workers—Program Includes Transcontinental Tour

DAVID BRUCE IS WORLD FAMOUS PARASITOLOGIST

Inaugural Address Will Deal With Advances in Knowledge of Disease

MANY DISCOVERIES

Isolated the Germ of Sleeping Sickness, Malta and Tsetse Fever

BRITISH ASSOCIATION FOR ADVANCEMENT OF SCIENCE IN NINETY-FOURTH YEAR HAS FINE RECORD OF ACHIEVEMENT

LECTURES BY ABLE SCIENTISTS TO BE OPEN TO PUBLIC

Foremost Savants Will Deliver Addresses to Citizens and Children—Technical Papers Will Be Read to Members of Sections Dealing With Depts. of Science

Eminent British Astronomer Will Give Citizens Lecture On Subject Of Relativity

Sir David Brewster

Charles Babbage

Sir John Herschel

SIR ALPHABET FUNCTION

By CHARLES BABBAGE, M.A., F.R.S.
(Written 1822)

The Verses Now Published for the First Time Illustrate the Difficulties of a Young Man Making a Start in the World Equipped With High Academic Distinction—The Extracts are Copied from the Original MS in Possession of the Author's Great-Grandson, Who Resides in Montreal

SCIENCE NOT DESTRUCTIVE: CIVILIZATION MUST USE NEW KNOWLEDGE FOR GOOD

By SIR OLIVER LODGE

Science Worker At Cambridge Active At Advanced Age

PRESERVING FILMS FOR 1,000 YEARS

PROPELLED BY GAS EJECTED FROM TAIL

*"Printed Material for the 1924 Annual Meeting, 1923-1924." Archive of the British Association for the Advancement of Science, 1923–1924. Wiley Digital Archives.*

## FILE THIS UNDER

Advancement of Science, Theology, Progress, Government, Gentrification, History of Science, Founding Societies, Professionalizing Science

## HISTORICAL CONTEXT

From its beginning, the British Association sought to define itself as fundamentally different from other learned societies, particularly the Royal Society, by calling itself the Association for the Advancement of Science (BAAS). Science historian Jack Morrell describes the BAAS as "the first national pressure group for professionalizing science."

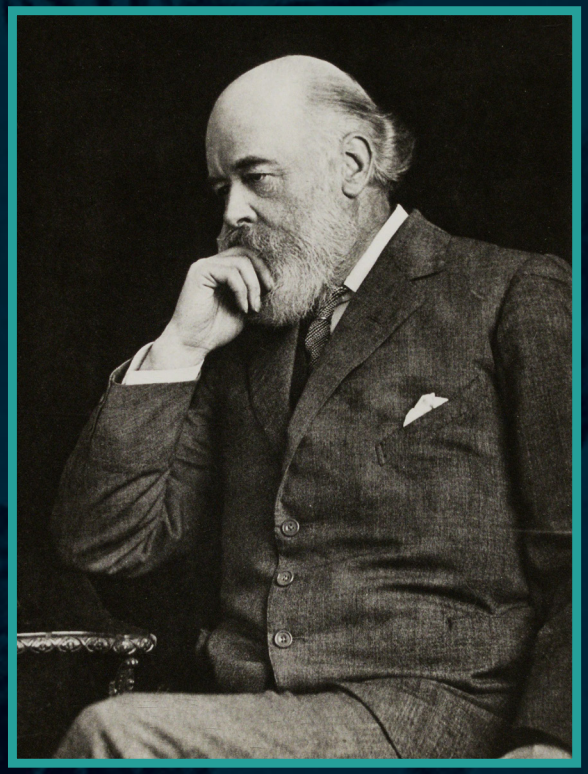
In 1830's Britain, science was dominated by wealthy individuals who often viewed the scientific world through a lens of religion and theology. Writing in 1830, Charles Babbage published a paper on what he viewed as "the decline of science in England". Physicist David Brewster, one of the founding members of the BAAS, wrote to Babbage that his paper was "the most heart-breaking subject that I know" and that "this is the moment to do something effectual, and that an association should be organized for the reviving of science in England".

As a result, the British Association for the Advancement of Science was founded in 1831. The British scientific community joined forces to transform the scientific profession from a pastime of the wealthy to an organized center aiming to share knowledge, educate the public and advance science.

## WHO
Sir Oliver Lodge

## WHY HE'S NOTABLE
British physicist and writer Sir Oliver Lodge (1851-1940), the very first Professor of Physics at the University of Liverpool, was best known for his contributions to the development of wireless telegraphy. He perfected a device called a coherer, which detected Morse code signals transmitted by radio wave and enabled them to be transcribed on paper by an inker.

He is also remembered as one of the first large-scale public educators, whose lectures and theatrical live experiments often drew crowds of thousands. Lodge was a member of several local bodies, as his spiritual and political beliefs brought him into contact with people of many different backgrounds and social classes. Having authored over 1500 publications, his efforts to engage with and educate the general public through weekly lectures distinguishes him as one of history's first great science communicators. In his later years, Lodge, along with his friend Sir Arthur Conan Doyle, became a keen investigator and writer on spiritualism and psychic phenomena following the death of his youngest son during World War I in 1915.

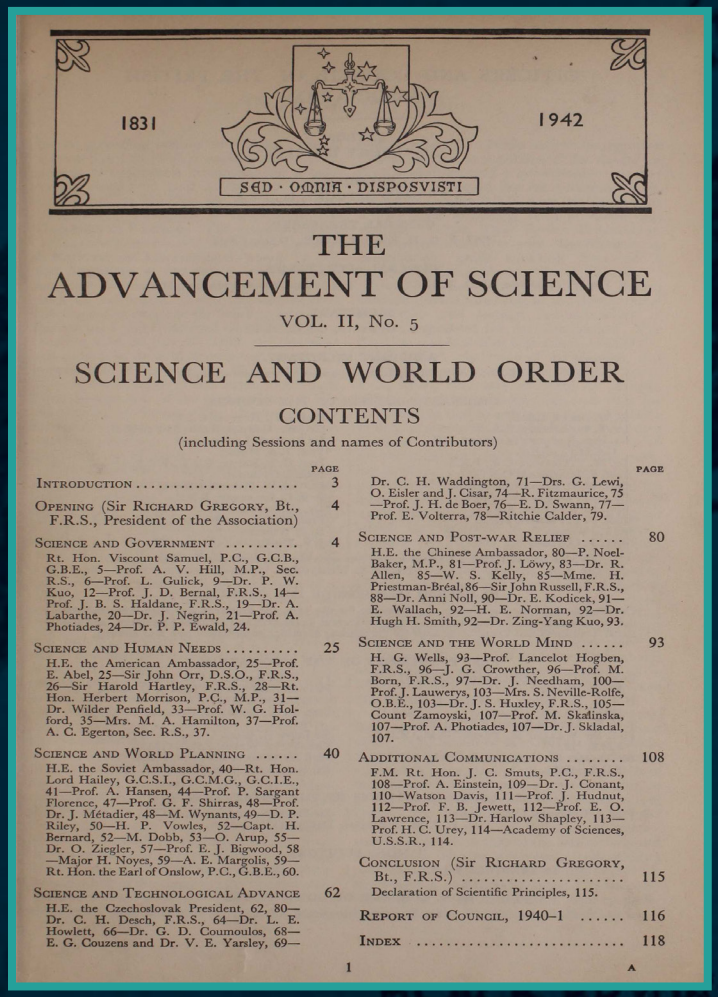


*Lodge, Oliver. Photograph of Sir Oliver Lodge Together with the [Original] Negative and a [Modern] Print Taken from the Same. 1930. Wiley Digital Archives.*

***Related items & special collections in the BAAS Archive:*** *The Oliver Lodge Papers contain 30 of Lodge's research notebooks up to 1912 (including some from his student days), photographs, loose notes, printed material, and letters from correspondents including Lodge, Davies, Larmor and Fitzgerald.*

***Sources:***
*https://archiveshub.jisc.ac.uk/search/archives/42ee37aa-f294-323c-8451-157ae24b4e14*
*https://www.britannica.com/biography/Oliver-Joseph-Lodge*

# Science and Policy



1831 1942

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THE
ADVANCEMENT OF SCIENCE

VOL. II, No. 5

SCIENCE AND WORLD ORDER

CONTENTS

(including Sessions and names of Contributors)



1 A

*"The Advancement of Science Vol. II." BAAS Monographs, Printed in England at the Ballantyne Press Spottiswoode, Ballantyne & Co. Ltd., 1942–1943. Wiley Digital Archives.*

## FILE THIS UNDER

British History, Political Science, Global Health Policy, General History Research, Health Education, Public Health, History of Science, Social Factors in Health, Funding of Science, International Relations, Social Studies, History of Industrial Design

## HISTORICAL CONTEXT

Policy has influenced the funding of public works and science for thousands of years. Throughout history, the systems of economic support for scientists and their work have been important determinants of the character and pace of scientific research. The ancient foundations of the sciences were initially driven by practical and religious concerns as well as the pursuit of philosophy. Early advances in areas like mathematics, astronomy and engineering were byproducts of more practical and immediate goals, like the creation of the calendar for agricultural purposes.

As the pace of technological progress increased before and during the Industrial Revolution, most scientific research was carried out by individual inventors using their own funds. In the 18th and 19th centuries, however, many disciplines began to professionalize, and scientific investigation began to be more predominantly tied to government and institutional funding. As science was professionalized, a number of societies and scientific organizations were created to enable scientific research and discovery, facilitate the spread of information and influence policy decisions.

## WHAT

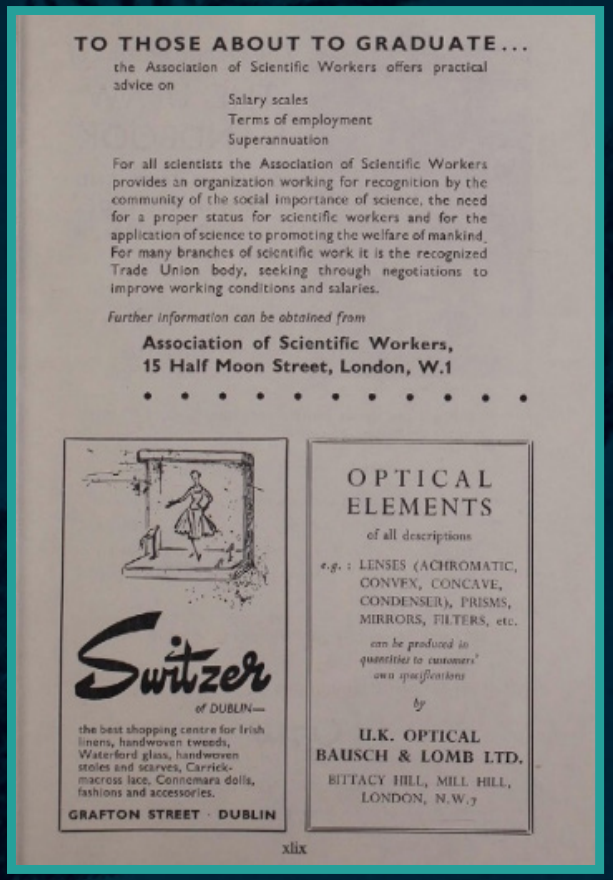
The Association of Scientific Workers

## WHY IT'S NOTABLE

Associations of scientific workers concerned with the problems of scientists in general, in addition to specialists in particular techniques, began with the foundation of the National Union of Scientific Workers in the United Kingdom in 1918. Originally a trade union, the National Union of Scientific Workers changed its name to the Association of Scientific Workers (AScW) in 1927.

The Association of Scientific Workers largely represented laboratory and technical workers in universities, the National Health Service and in chemical and metal manufacturing. It was the union for scientists "with a conscience" and could name half-a-dozen Nobel Prize winners amongst its membership. In the 1930s, the Association of Scientific Workers joined forces with the BAAS to lobby the state department for increased coordination of scientists, extensive coordination around graduate employment of scientists, international outreach of science and the employment of foreign nationals in scientific endeavors during World War II.

The success of the Association, with its young and widely diverse membership, made a deep impression in many countries around the world, leading to the foundation of the World Federation of Scientific Workers in 1946.

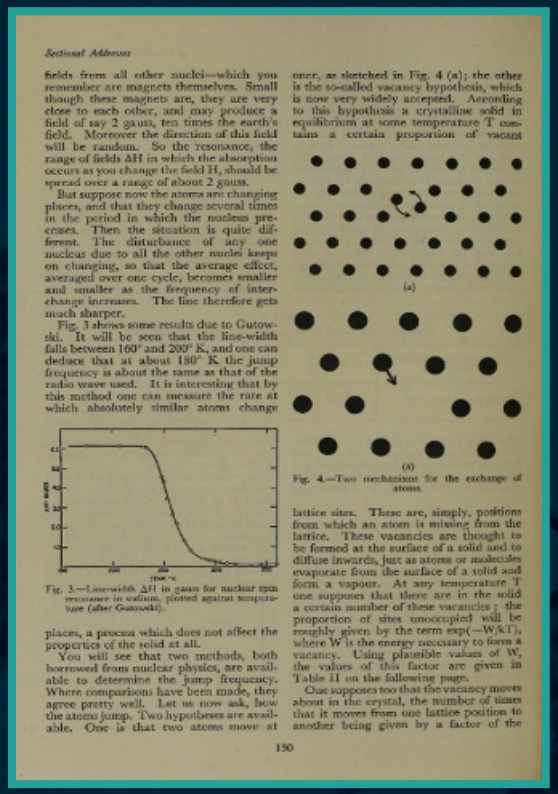



*"British Association for the Advancement of Science Annual Meeting Dublin September 4th-11th 1957 Programme." BAAS Monographs, Printed in Great Britain by Spottiswoode, Ballantyne & Co. Ltd., 4–11 Sept. 1957. Wiley Digital Archives.*

***Related Items & Special Collections in the BAAS Archive:*** *Papers, files, reports and meeting minutes related to science and policy in various organizations, including the Association of Scientific Workers, The British Science Guild, The Indian Science Congress Association and more.*

***Sources:***
*https://en.wikipedia.org/wiki/History_of_science_policy*
*https://en.wikipedia.org/wiki/Association_of_Scientific_Workers*

# 19th – 20th Century Physics



Sectional Addresses

fields from all other nuclei—which you remember are magnets themselves. Small though these magnets are, they are very close to each other, and may produce a field of say 2 gauss, ten times the earth's field. Moreover the direction of this field will be random. So the resonance, the range of fields ΔH in which the absorption occurs as you change the field H, should be spread over a range of about 2 gauss.

But suppose now the atoms are changing places, and that they change several times in the period in which the nucleus precesses. Then the situation is quite different. The disturbance of any one nucleus due to all the other nuclei keeps on changing, so that the average effect, averaged over one cycle, becomes smaller and smaller as the frequency of interchange increases. The line therefore gets much sharper.

Fig. 3 shows some results due to Gutowski. It will be seen that the line-width falls between 160° and 200° K, and one can deduce that at about 180° K the jump frequency is about the same as that of the radio wave used. It is interesting that by this method one can measure the rate at which absolutely similar atoms change

Fig. 3.—Line-width ΔH in gauss for nuclear spin resonance in sodium, plotted against temperature (after Gutowski).

places, a process which does not affect the properties of the solid at all.

You will see that two methods, both borrowed from nuclear physics, are available to determine the jump frequency. Where comparisons have been made, they agree pretty well. Let us now ask, how the atoms jump. Two hypotheses are available. One is that two atoms move at once, as sketched in Fig. 4 (a); the other is the so-called vacancy hypothesis, which is now very widely accepted. According to this hypothesis a crystalline solid in equilibrium at some temperature T contains a certain proportion of vacant

(a)

(b)

Fig. 4.—Two mechanisms for the exchange of atoms.

lattice sites. These are, simply, positions from which an atom is missing from the lattice. These vacancies are thought to be formed at the surface of a solid and to diffuse inwards, just as atoms or molecules evaporate from the surface of a solid and form a vapour. At any temperature T one supposes that there are in the solid a certain number of these vacancies; the proportion of sites unoccupied will be roughly given by the term $\exp(-W/kT)$, where W is the energy necessary to form a vacancy. Using plausible values of W, the values of this factor are given in Table II on the following page.

One supposes too that the vacancy moves about in the crystal, the number of times that it moves from one lattice position to another being given by a factor of the

150

*"The Advancement of Science Vol. XII."*
*BAAS Monographs, Printed in Great Britain*
*Spottiswoode, Ballantyne & Co. Ltd., 1955–1956.*
*Wiley Digital Archives.*

## FILE THIS UNDER

British History, Physics, General Science Studies, General History Research, History of Physical Science, History of Science, Funding of Science, International Relations

## HISTORICAL CONTEXT

Physics, the branch of science whose primary objects of study are matter, energy and force, is one of the most fundamental scientific disciplines. Its main goal is to understand how the universe behaves, and it is concerned with all aspects of nature on both the macroscopic and submicroscopic levels.

During the 19th century, there were momentous advances in the field of physics, from areas such as mechanics and electromagnetism to the formulation of the laws of thermodynamics and the atomic theory of matter.

By the end of the 19th century, physics had evolved to the point at which classical mechanics could cope with highly complex problems involving macroscopic situations, thermodynamics and kinetic theory. Geometrical and physical optics could be understood in terms of electromagnetic waves and the conservation laws for energy, momentum and mass were widely accepted. It was, therefore, widely accepted that important laws of physics had been discovered and that research would be concerned with improvements of method and measurement.

However, at the beginning of the 20th century, a major revolution shook the world of physics, which led to a new era, generally referred to as modern physics. Modern physics is based on the two major breakthroughs of the early 20th century: relativity and quantum physics.

## WHO

Lord Kelvin (William Thomson), revolutionary contributor to electricity, magnetism and thermodynamics

## WHY HE'S NOTABLE

Lord Kelvin (William Thomson) was an eminent physicist who was born in Belfast in 1824. He attended university classes from the age of 10 and wrote his first scientific paper at the age of 16. From 1841 to 1845, Kelvin attended Cambridge University, and after graduating, he began working in a Paris laboratory with physics professor Victor Regnault.

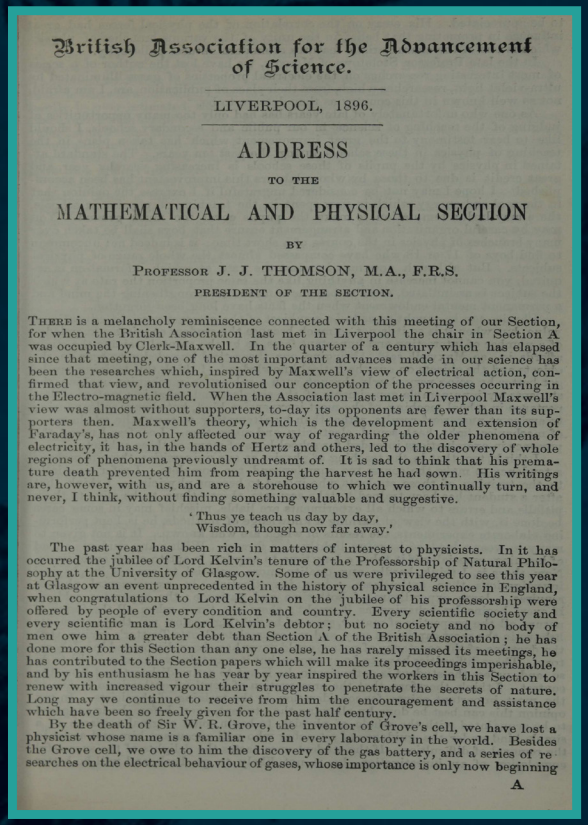
In 1846, at the age of 22, Kelvin returned to Glasgow to become a Professor of Natural Philosophy, a post he retained for 53 years. There, he established the first university physics laboratory.

Kelvin studied the nature of heat and realized that it would be useful to be able to define extremely low temperatures more precisely; in 1848, he proposed an absolute temperature scale, now called the Kelvin scale. He also formulated the second law of thermodynamics, which states that heat will not flow from a colder to a hotter body.

Kelvin's interest in the transmission of electricity prompted his appointment as Director of the Atlantic Telegraph Company in 1856. Thanks to his persistence in this role, the first telegraph cable was successfully installed under the Atlantic Ocean. Kelvin received a knighthood for his efforts on this project.

Kelvin became a Lord in 1892 and took the name Kelvin because of his Glasgow connections. By the time of his death in 1907, he was an international celebrity, widely respected and honored.

***Sources:***
*https://digital.nls.uk/scientists/biographies/lord-kelvin/*



British Association for the Advancement of Science.

LIVERPOOL, 1896.

ADDRESS

TO THE

MATHEMATICAL AND PHYSICAL SECTION

BY

PROFESSOR J. J. THOMSON, M.A., F.R.S.

PRESIDENT OF THE SECTION.

THERE is a melancholy reminiscence connected with this meeting of our Section, for when the British Association last met in Liverpool the chair in Section A was occupied by Clerk-Maxwell. In the quarter of a century which has elapsed since that meeting, one of the most important advances made in our science has been the researches which, inspired by Maxwell's view of electrical action, confirmed that view, and revolutionised our conception of the processes occurring in the Electro-magnetic field. When the Association last met in Liverpool Maxwell's view was almost without supporters, to-day its opponents are fewer than its supporters then. Maxwell's theory, which is the development and extension of Faraday's, has not only affected our way of regarding the older phenomena of electricity, it has, in the hands of Hertz and others, led to the discovery of whole regions of phenomena previously undreamt of. It is sad to think that his premature death prevented him from reaping the harvest he had sown. His writings are, however, with us, and are a storehouse to which we continually turn, and never, I think, without finding something valuable and suggestive.

'Thus ye teach us day by day,
Wisdom, though now far away.'

The past year has been rich in matters of interest to physicists. In it has occurred the jubilee of Lord Kelvin's tenure of the Professorship of Natural Philosophy at the University of Glasgow. Some of us were privileged to see this year at Glasgow an event unprecedented in the history of physical science in England, when congratulations to Lord Kelvin on the jubilee of his professorship were offered by people of every condition and country. Every scientific society and every scientific man is Lord Kelvin's debtor; but no society and no body of men owe him a greater debt than Section A of the British Association; he has done more for this Section than any one else, he has rarely missed its meetings, he has contributed to the Section papers which will make its proceedings imperishable, and by his enthusiasm he has year by year inspired the workers in this Section to renew with increased vigour their struggles to penetrate the secrets of nature. Long may we continue to receive from him the encouragement and assistance which have been so freely given for the past half century.

By the death of Sir W. R. Grove, the inventor of Grove's cell, we have lost a physicist whose name is a familiar one in every laboratory in the world. Besides the Grove cell, we owe to him the discovery of the gas battery, and a series of researches on the electrical behaviour of gases, whose importance is only now beginning

A

*"British Association for the Advancement of Science." BAAS Monographs, Printed by Spottiswoode and Co., 1894–1900. Wiley Digital Archives.*

***Related Items & Special Collections in the BAAS Archive:*** *Volumes of appointments to committees, meeting reports, Physics notes and course guides, papers and notes on the laws of Physics, lecture notes on thermodynamics and more.*

## WHO

Sir Charles Wheatstone, Father of the Wheatstone Bridge

## WHY HE'S NOTABLE

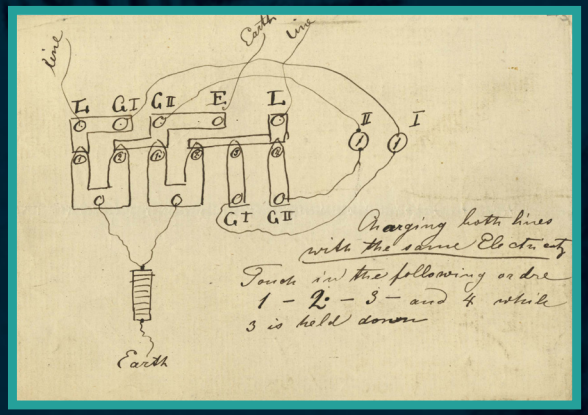
Sir Charles Wheatstone was an English physicist who was born in 1802 in Gloucestershire, England.

Wheatstone was appointed Professor of Experimental Philosophy at King's College London in 1834, the same year that he used a revolving mirror in an experiment to measure the speed of electricity in a conductor. The same revolving mirror was later used in measurements of the speed of light.

In 1837, Wheatstone patented an early telegraph with Sir William Fothergill Cooke of England. He also invented the concertina, a type of small accordion, and the stereoscope, a device for observing pictures in three dimensions still used in viewing X-rays and aerial photographs. He initiated the use of electromagnets in electric generators and invented the Playfair cipher, an encryption technique based on substituting different pairs of letters for paired letters in a message.

Sir Charles Wheatstone is best known for his contributions in the development of the Wheatstone Bridge, originally invented by Samuel Hunter Christie, which is used to measure an unknown electrical resistance.

In 1868, he was knighted for his achievements in physics.

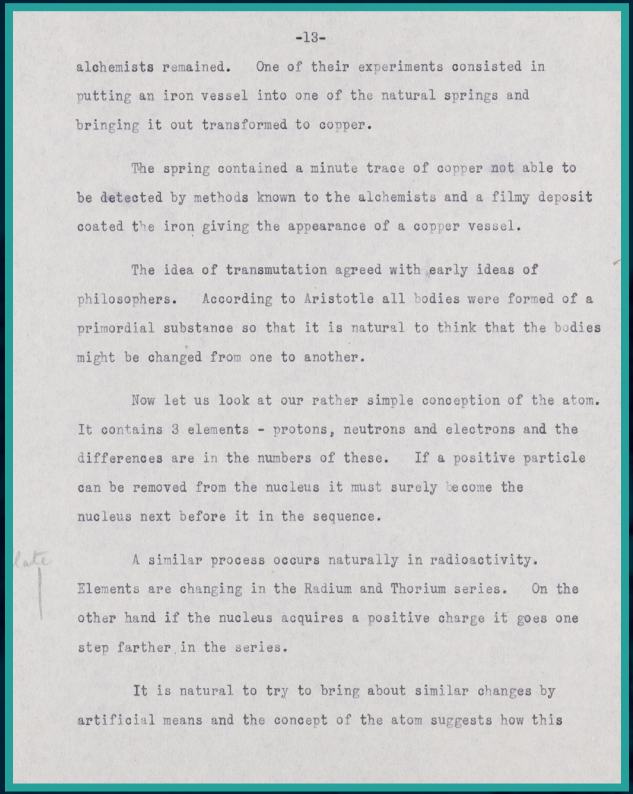



*Draft by Sir Charles Wheatstone.*
*Source: King's College London Archive.*

***Related Items & Special Collections in the BAAS Archive:*** *The Wheatstone Collection, meeting reports, Physics notes and course guides, papers and notes on the laws of Physics, lecture notes on thermodynamics, catalogs of inventions and more.*

***Sources:***
*https://www.britannica.com/biography/Charles-Wheatstone*

# 19th – 20th Century Chemistry



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alchemists remained. One of their experiments consisted in putting an iron vessel into one of the natural springs and bringing it out transformed to copper.

The spring contained a minute trace of copper not able to be detected by methods known to the alchemists and a filmy deposit coated the iron giving the appearance of a copper vessel.

The idea of transmutation agreed with early ideas of philosophers. According to Aristotle all bodies were formed of a primordial substance so that it is natural to think that the bodies might be changed from one to another.

Now let us look at our rather simple conception of the atom. It contains 3 elements - protons, neutrons and electrons and the differences are in the numbers of these. If a positive particle can be removed from the nucleus it must surely become the nucleus next before it in the sequence.

A similar process occurs naturally in radioactivity. Elements are changing in the Radium and Thorium series. On the other hand if the nucleus acquires a positive charge it goes one step farther in the series.

It is natural to try to bring about similar changes by artificial means and the concept of the atom suggests how this

*Flint, Henry. "Manuscript & 3 Lectures on the Chemical Elements." Henry Flint Papers, No Date. Wiley Digital Archives.*

## FILE THIS UNDER

British History, Chemistry, General Science Studies, General History Research, Health Education, History of Science, Funding of Science, International Relations, Physical Sciences, Social Studies

## HISTORICAL CONTEXT

One of the youngest of the natural sciences, the foundational aspects of chemistry were laid in the late 18th century when attempts were made to explain the most striking of all ordinary chemical changes - namely, fire or combustion.

19th-century chemistry has often been described as a smooth sequence of discoveries that gradually established modern chemistry, from the distinction between atoms and molecules in atomic theory, to the discovery of new elements and compounds.

Chemistry in the 20th century was characterized by spectacular growth and advances, stimulated by revolutionary theories and experimental breakthroughs. Yet, despite this rapid development, the history of this scientific discipline has only recently achieved the status necessary to understand the effects of chemistry on the scientific and technological culture of the modern world.

## WHO

Sir William Ramsay, recipient of the Nobel Prize in Chemistry in 1904

## WHY HE'S NOTABLE

Sir William Ramsay was born in Glasgow in 1852. In 1872, he earned the degree of Doctor of Philosophy in Fittig's laboratory at Tübingen. On his return to Scotland in 1871, he became an assistant in chemistry at the Anderson College in Glasgow, later becoming a professor at University College, Bristol. In 1887, he joined University College, London as the Chair of Inorganic Chemistry, where he remained until his retirement in 1913.

Ramsay's earliest works were in the field of organic chemistry. In the 1890s, he was chiefly active in physical chemistry, his many contributions to this branch of chemistry being mostly in the areas of stoichiometry and thermodynamics.

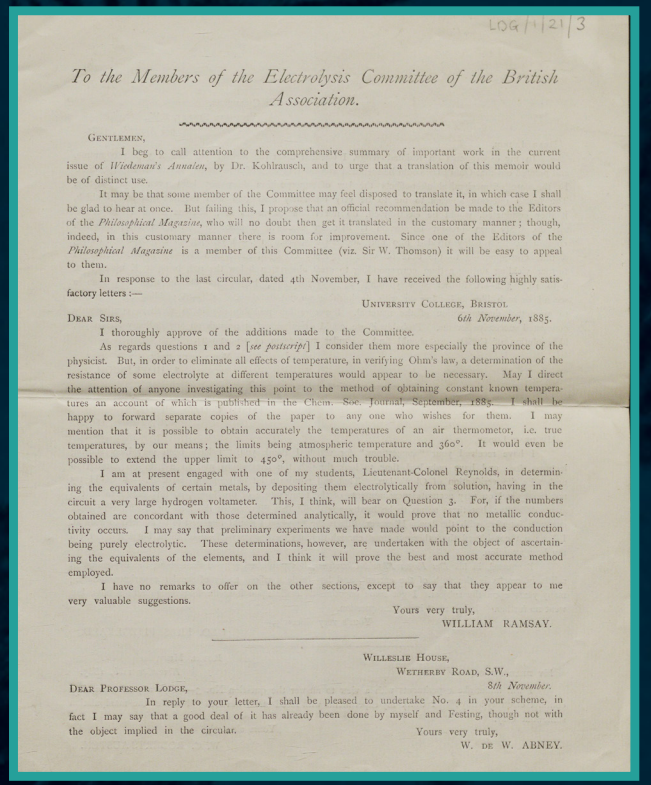
Ramsay's most celebrated discoveries, however, were in the study of inorganic chemistry. As early as 1885-1890 he published several notable papers on the oxides of nitrogen and followed those up with the discovery of argon, helium, neon, krypton and xenon.

At the BAAS annual meeting in August 1894, Sir William Ramsay and Lord Rayleigh jointly announced the discovery of argon. While seeking sources of argon in the mineral kingdom, Ramsay discovered helium in 1895. Guided by theoretical considerations founded on Mendeleev's periodic system, he then methodically sought the missing links in the new group of elements and found neon, krypton, and xenon in 1898.

In 1904, Sir William Ramsay received the Nobel Prize in Chemistry "in recognition of his services in the discovery of the inert gaseous elements in air."

***Sources:***

*https://www.nobelprize.org/prizes/chemistry/1904/ramsay/biographical/*
*https://www.scientificamerican.com/article/an-outline-of-the-progress-of-chemi/*



LOG/1/21/3

*To the Members of the Electrolysis Committee of the British Association.*

GENTLEMEN,

I beg to call attention to the comprehensive summary of important work in the current issue of *Wiedemann's Annalen*, by Dr. Kohlrausch, and to urge that a translation of this memoir would be of distinct use.

It may be that some member of the Committee may feel disposed to translate it, in which case I shall be glad to hear at once. But failing this, I propose that an official recommendation be made to the Editors of the *Philosophical Magazine*, who will no doubt then get it translated in the customary manner; though, indeed, in this customary manner there is room for improvement. Since one of the Editors of the *Philosophical Magazine* is a member of this Committee (viz. Sir W. Thomson) it will be easy to appeal to them.

In response to the last circular, dated 4th November, I have received the following highly satisfactory letters:—

UNIVERSITY COLLEGE, BRISTOL.

DEAR SIRS, *6th November*, 1885.

I thoroughly approve of the additions made to the Committee.

As regards questions 1 and 2 [*see postcript*] I consider them more especially the province of the physicist. But, in order to eliminate all effects of temperature, in verifying Ohm's law, a determination of the resistance of some electrolyte at different temperatures would appear to be necessary. May I direct the attention of anyone investigating this point to the method of obtaining constant known temperatures an account of which is published in the Chem. Soc. Journal, September, 1885. I shall be happy to forward separate copies of the paper to any one who wishes for them. I may mention that it is possible to obtain accurately the temperatures of an air thermometer, i.e. true temperatures, by our means; the limits being atmospheric temperature and 360°. It would even be possible to extend the upper limit to 450°, without much trouble.

I am at present engaged with one of my students, Lieutenant-Colonel Reynolds, in determining the equivalents of certain metals, by depositing them electrolytically from solution, having in the circuit a very large hydrogen voltameter. This, I think, will bear on Question 3. For, if the numbers obtained are concordant with those determined analytically, it would prove that no metallic conductivity occurs. I may say that preliminary experiments we have made would point to the conduction being purely electrolytic. These determinations, however, are undertaken with the object of ascertaining the equivalents of the elements, and I think it will prove the best and most accurate method employed.

I have no remarks to offer on the other sections, except to say that they appear to me very valuable suggestions.

Yours very truly,
WILLIAM RAMSAY.

WILLESLIE HOUSE,
WETHERBY ROAD, S.W.,
*8th November.*

DEAR PROFESSOR LODGE,

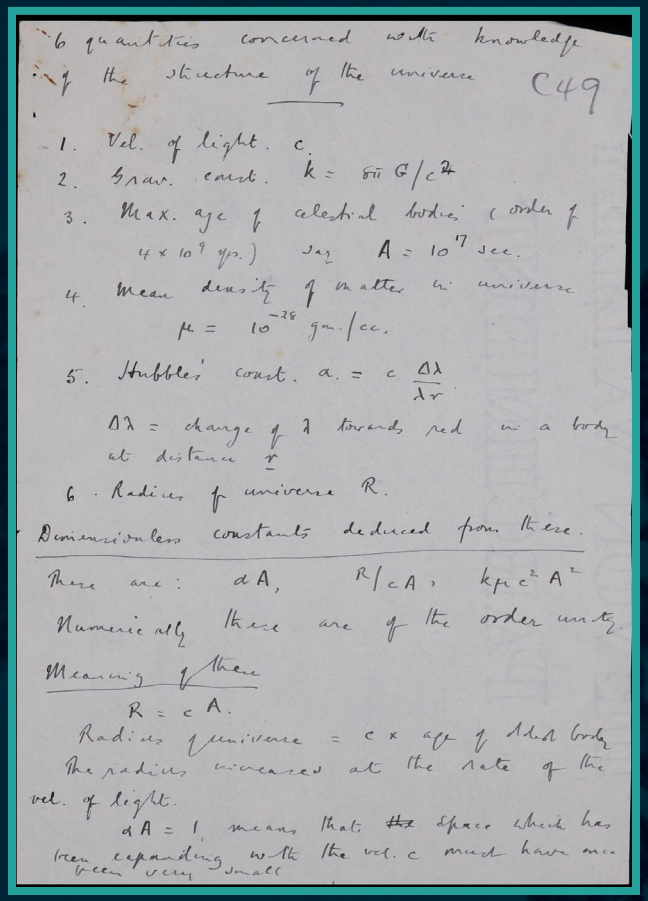
In reply to your letter, I shall be pleased to undertake No. 4 in your scheme, in fact I may say that a good deal of it has already been done by myself and Festing, though not with the object implied in the circular.

Yours very truly,
W. DE W. ABNEY.

*Lodge, Oliver. Theories of Electrolysis. 1886–1895. Wiley Digital Archives.*

***Related Items & Special Collections in the BAAS Archive**: The Ramsay Collection, which features lab books, papers, lectures and correspondence. Papers and reports of committees, meeting minutes, accounts on the study of chemistry.*

# 19th – 20th Century Astronomy



6 quantities concerned with knowledge of the structure of the universe C49

1. Vel. of light. c
2. Grav. const. $k = 8\pi G/c^2$
3. Max. age of celestial bodies (order of $4 \times 10^9$ yrs.) say $A = 10^{17}$ sec.
4. Mean density of matter in universe $\mu = 10^{-28}$ gm./cc.
5. Hubbles' const. $a = c \frac{\Delta\lambda}{\lambda r}$

$\Delta\lambda$ = change of $\lambda$ towards red in a body at distance $r$

6. Radius of universe $R$.

Dimensionless constants deduced from these.

There are: $dA$, $R/cA$, $k\mu c^2 A^2$

Numerically these are of the order unity.

Meaning of these

$R = cA$.

Radius of universe = c × age of that body. The radius increases at the rate of the vel. of light.

$dA = 1$ means that ~~the~~ space which has been expanding with the vel. c must have once been very small

*Flint, Henry. "6 Qualities Concerned with Knowledge of the Structure of the Universe." Henry Flint Papers, No Date. Wiley Digital Archives.*

## FILE THIS UNDER

Scientific Innovation, Astronomy, Stars, Planets, Elements, Expansion of the Universe

## HISTORICAL CONTEXT

In the 19th and 20th centuries, astronomers progressed from mapping the skies to understanding their composition and predicting what could not be seen. The introduction of photography and improvement of telescopes led to the study and identification of objects located further and further away.

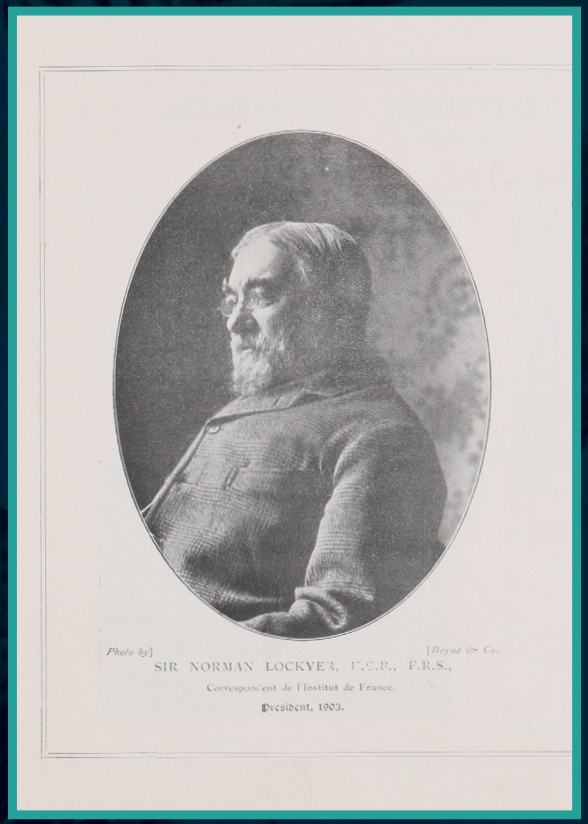
While 18th-century astronomers were preoccupied with measuring the position and categorization of celestial objects, 19th-century astronomers applied developments in mathematics, physics, chemistry and geology to understand the make-up of these bodies and the origins of the universe. Astronomers were now interested in finding out exactly what a star, comet or planet consisted of and how each was formed.

## WHO
Sir Norman Lockyer

## WHY HE'S NOTABLE
Although Joseph Norman Lockyer started his career as a civil servant in the War Office in his 20s, he always had his eye on the sky, and he soon moved on from amateur astronomy to become a pioneering astrophysicist.

By fitting a spectrograph on a telescope, he was able to study the solar atmosphere in broad daylight without having to wait for a solar eclipse - a revolutionary advancement in itself. This capability enabled him to identify an unknown element in the sun's spectrum, which led to the discovery of helium. Five thousand miles away, Pierre Janssen made that same observation while viewing a solar eclipse during an expedition to India.

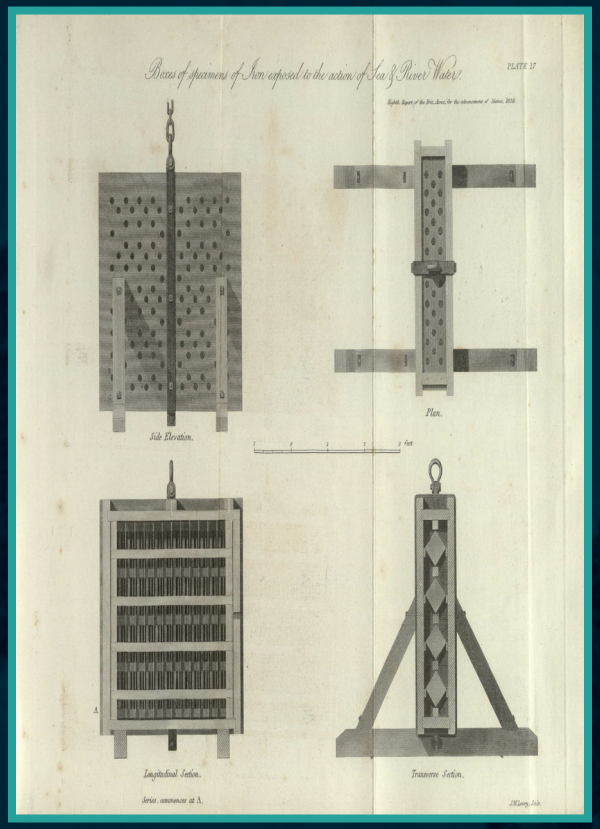
Because both scientists' papers detailing their observations arrived at the French Academy of Sciences the same day, both received credit for the discovery. In 1903, Lockyer was elected as president of the BAAS.




*"Printed Material for Annual Meetings, 1902-1903." Archive of the British Association for the Advancement of Science, 1902–1903. Wiley Digital Archives.*

***Related Items & Special Collections in the BAAS Archive:*** *In 1925, the BAAS introduced a memorial lecture to their annual meetings named the "Norman Lockyer Lecture". The archive contains a collection of correspondence, minute-books, reports, programmes and ephemera relating to the organization of the annual meetings. They are arranged chronologically from 1831-1965.*

# 19th – 20th Century Engineering




*"Catalogue of the Philosophical Instruments Models of Inventions, Products of National Industry, &c. &c. Contained in the First Exhibition of the British Association for the Advancement of Science." BAAS Monographs, Printed by John Hernaman, Aug. 1838. Wiley Digital Archives.*

## FILE THIS UNDER

British History, Physics, General Science Studies, General History Research, History of Engineering, History of Science, Funding of Science, International Relations

## HISTORICAL CONTEXT

Although humans have always adapted their environment to suit their needs and wants, engineering as we know it today emerged during the 16th century, when specialists used mathematics to design military fortifications.

Starting in the mid-19th century, as new processing methods reshaped transportation, construction and manufacturing, scientists, inventors and entrepreneurs made advances in all areas. It was in the late 1800s that inventors began identifying with the engineering process and the engineering profession began to divide into specialist disciplines, such as civil, mechanical, chemical and electrical engineering.

In the 20th century, engineering took us into space, gave us cars and highways, made our waters cleaner and revolutionized the way we produce food. A new wave of global technological progress spread with the development of household appliances and the invention of the telephone, radio, television and more.

## WHO

Dr. Herbert Chatley

## WHY HE'S NOTABLE

Dr. Herbert Chatley was born in London in 1885. He was educated at the Northern Polytechnic of London University, after which he was a lecturer in civil engineering at the Municipal College, Portsmouth. He then became Professor of Civil Engineering at Tongshan Engineering College in North China, a post which he held until 1915.

As a civil engineer, Dr. Chatley was an authority on dredging and dredging plant, and he was the author of many publications on the subject. He also wrote on the theory of flight and on rocket propulsion, including his most notable publication, The Problem of Flight: A Text-Book of Aerial Engineering.

From 1915 to 1916, Dr. Chatley served with the Nanking-Hunan Railway as a District Engineer. In 1916, he joined the Whangpoo Conservancy Board, Shanghai, as Assistant Engineer, undertaking important dredging works and making valuable studies of the mud and silt in the Whangpoo and Yangtze estuaries. His work included supervising the construction of locally built dredging plant. He became Engineer-in-Chief in 1928 and remained there until his retirement in 1937, when he returned to London to practice as a consultant. On retiring from China, Dr. Chatley was awarded the Chinese Order of the Brilliant Jade in recognition of his services.

From 1940 until 1946, he joined the Department of the Civil Engineer to the Admiralty as Superintending Civil Engineer. For his work while with the Admiralty, the French Government made him an officer of the Legion of Honour. He was also a member of the Institution of Civil Engineers in Ireland, an associate fellow of the Royal Aeronautical Society and an associate of the Institute of Physics.

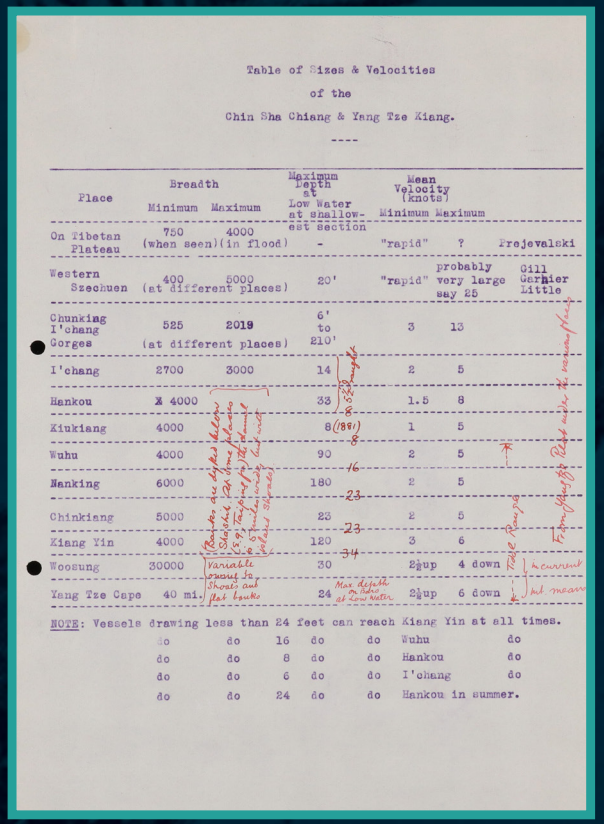


Table of Sizes & Velocities
of the
Chin Sha Chiang & Yang Tze Kiang.

| Place | Breadth Minimum | Breadth Maximum | Maximum Depth at Low Water at Shallowest Section | Mean Velocity (knots) Minimum | Maximum | |
|---|---|---|---|---|---|---|
| On Tibetan Plateau | 750 (when seen) | 4000 (in flood) | - | "rapid" | ? | Prejevalski |
| Western Szechuen | 400 (at different places) | 5000 | 20' | "rapid" | probably very large say 25 | Gill Garnier Little |
| Chunking I'chang Gorges | 525 (at different places) | 2019 | 6' to 210' | 3 | 13 | |
| I'chang | 2700 | 3000 | 14 | 2 | 5 | |
| Hankou | 4000 | | 33 | 1.5 | 8 | |
| Kiukiang | 4000 | | 8 (1881) | 1 | 5 | |
| Wuhu | 4000 | | 90 | 2 | 5 | |
| Nanking | 6000 | | 180 | 2 | 5 | |
| Chinkiang | 5000 | | 23 | 2 | 5 | |
| Kiang Yin | 4000 | | 120 | 3 | 6 | |
| Woosung | 30000 | | 30 | 2½up | 4 down | |
| Yang Tze Cape | 40 mi. | | 24 | 2½up | 6 down | |

NOTE: Vessels drawing less than 24 feet can reach Kiang Yin at all times.
do do 16 do do Wuhu do
do do 8 do do Hankou do
do do 6 do do I'chang do
do do 24 do do Hankou in summer.

*Chatley, Herbert. "Papers, Reports, Drafts." Herbert Chatley Papers, 1915–1938. Wiley Digital Archives.*

***Related Items & Special Collections in the BAAS Archive:*** *The Chatley Collection, containing papers, reports, drafts and lectures, papers on electrical engineering, reports on the mechanics of rotation, notebooks on cyclical theory and more.*

***Sources:***

*https://www.linkengineering.org/Explore/what-is-engineering/*
*http://adsabs.harvard.edu/full/1956MNRAS.116..144*
*https://www.icevirtuallibrary.com/doi/pdf/10.1680/iicep.1955.11414*

# About the British Association for the Advancement of Science

## Collections on the History of Science (1830s-1970s) Archive

Wiley Digital Archives' British Association for the Advancement of Science—Collections on the History of Science (1830s-1970s) archive is a uniquely interdisciplinary and interinstitutional archive, comprised of BAAS materials and collections from prestigious British universities, selected by a team of leading History of Science scholars.

This archive connects the works, thoughts and interactions of the most influential scientists of the time, from Kelvin to Ramsay. The materials within document 150 years of scientific discovery, Britain's emergence as a center for science, and provide an insider's perspective that researchers can't get anywhere else.

Content includes administrative records, press clippings, invitations to annual BAAS meetings, correspondence, illustrations, manuscripts, photographs, maps, prototypes and more.

To learn more about the British Association for the Advancement of Science—Collections on the History of Science (1830s-1970s) archive, visit wileydigitalarchives.com/british-association-for-the-advancement-of-science/.