From a Bell on a Rope to VoIP: The Evolution of the Lift Alarm in the U.K.

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Keywords: lift alarm, autodialler, emergency communication, PSTN, DTMF, emergency telephone, GSM

Abstract. The paper will give the reader the opportunity to learn about the evolution of the design and provisioning of devices used by lift passengers to signal for help, ‘alarm systems’, in the UK from four perspectives:

1. Requirements in British Standards
2. Design approaches from both lift and component manufacturers
3. Experiences of industry personnel installing and maintaining alarm systems
4. Impact of the development of telecommunications systems in the UK

The result is not only a summary of the development of requirements in British Standards and the design of alarm systems but also demonstrates how the various changes over the years continue to inform certain industry behaviours and approaches today. The inclusion of research into the telecommunications industry shows that whilst many of us may, at times, see our industry as “an island”, decisions made in other adjacent industries have impacted and will continue to impact the UK lift industry.

1 INTRODUCTION

The story of the passenger lift as we know it today is inherently linked to the advances in safety which have served to reassure passengers that lifts are a safe means of transportation. Many of these same safety features are designed to stop the lift car mid-travel, and keep the lift car stopped until a lift engineer can safely return the lift to service. Depending on the age and type of the lift, it’s highly likely that the lift will stop between floors. A passenger finding themselves in a stalled lift car will often fail to appreciate that they are in fact in the safest place they could be in the event of a lift breakdown. Therefore, a means for a passenger to summon help, so that competent and qualified personnel can release them from the lift is, it could be argued, essential to the safe operation of a passenger lift. The form that this ‘alarm’ should take has been a topic of debate for many years.

2 EARLY GUIDANCE FOR THE LIFT INDUSTRY

Stories persist about early systems consisting of a brass bell being installed on top of the lift car operated by pulling on a rope from within the lift car. Anecdotal evidence suggests that a system like this was still installed at a hotel in Norfolk as late as 2016 and served as the primary alarm on the lift. Research has thus far been unable to yield any documentary evidence regarding this design approach or if there was ever a system like it formally adopted.

The first documented guidance on lift alarms appears in the Building Industries National Council ‘Code of Practice for the Installation of Lifts and Escalators’ [1] published in 1935. This was the first dedicated lift safety code in the UK[1] and was compiled following a review of existing legislation in

[1] Page 1, Lee E Gray, The 1935 Code of Practice for the Installation of Lifts and Escalators [2]

the UK and existing Codes in Europe and America. The section covering on the ‘lift car’ included a requirement for an alarm system:

> Lifts Cars 7.(b)
>
> The car of every automatically operated lift in which a passenger or operator is at any time carried, shall be fitted with an alarm bell and/or telephone circuit to enable assistance to be obtained in case of breakdown or failure between floors.[2]

In the 1943 Code Of Practice [3] the text of the requirement was simplified and used less perspective language:

> Lift Cars.13.(r)
>
> Every lift shall be provided with an emergency signal that is operative from the lift-car and audible outside of the lift-well, or it shall be provided with a telephone[3]

Here we can see the beginnings of a debate that would swing back and forth for the rest of the twentieth century and continue to the present day: is an “alarm bell” good enough?

The language used in the 1943 Code, ‘an emergency signal…*audible* outside of the lift-well’, helps illustrate the crux of the issue. An audible alarm is only of any use if there is someone there to hear it. Having heard the audible alarm, that person now needs to understand what the alarm is signalling and how they should respond to that signal.

A telephone allowing the trapped passenger to speak directly to another human being and request help reduces the risk that the alarm will be ignored or misunderstood.

Where a telephone was provided this would typically be a conventional rotary dial telephone of the era, installed in a cabinet within the lift car.

We’re given no guidance in either the 1935 or 1943 Codes about providing information for the trapped passengers on who to call from the provided telephone. It’s certainly possible this may have also signalled the start of “nuisance” calls from trapped passengers to the emergency services, which continue to frustrate the Fire and Rescue service to this day (more on that later).

During this era, it’s most likely that the trapped passengers would have spoken with an operator at the local telephone exchange who would have directed the call.

At this point, it’s worth diverting from the lift industry and looking at the telecommunications industry as it existed at the time.

3 THE PUBLIC SWITCHED TELEPHONE NETWORK (PSTN)

The General Post Office (GPO) in the UK provided telephone services from 1878 until its break up in the early 1970s. Whilst the GPO provided the vast majority of the Public Switched Telephone Network (PSTN) from 1911 onwards, it was not a total monopoly and private telephone companies persisted throughout its history (most notably ‘Kingston Communications’ in Kingston upon Hull).

The PSTN was built as a network of copper cables connecting GPO telephone exchange buildings both to one another and to individual telephones in buildings & public call boxes. At first, it was an

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[2] Page 14, Building Industries National Council, *Code of Practice for the Installation of Lifts and Escalators*
[3] Page 20, Building Industries National Council, *Code of Practice Electric Passenger and Goods Lifts and Escalators*

entirely manual system relying on human operators to connect calls. Efforts towards automation began in the 1920s and persisted until the last manual exchange was finally closed in 1975[4]. Certain features of the PSTN became important to the lift alarm application. The most important feature was the PSTN's 'power autonomy'.

The PSTN's copper lines carried their own power (~48VDC) which was provided separately from the general mains power grid in the UK. This meant that if there was a mains power cut, a key time for a lift trapping, a telephone line would still be available.

4 BRITISH STANDARDS 1957-1979

In 1957 the previous Code of Practice for lifts was replaced with a British Standard: BS2655-1 [5], published by the British Standards Institute (BSI).

Section two of BS2655-1, 'Specific requirements for passenger and goods lifts', reproduces the text from the 1943 Code of Practice:

> CAR EMERGENCY DEVICES
>
> 14. Every passenger lift shall be provided with an emergency signal that is operative from the lift car and audible outside the lift well, or it shall be provided with a telephone[5]

This requirement would remain unchanged in BS2655-1 through both its 1958 and 1970 versions [6,7].

Throughout this period the provisioning of alarm bells was the standard approach in the UK. As well as a bell on the lift car, some bodies also specified a secondary bell placed outside of the lift well within the building. The higher proportion of buildings with on-site staff also helped during this period.

'Block Wardens', in the original generation of council tower blocks built in the UK, were stationed on-site and responsible for the general upkeep of the block and could also raise the alarm in the event of a lift trapping. The small boarded-up offices, often converted to storage spaces, on the ground floor of older tower blocks are all that remains of this idealistic approach to mass high-rise living.

Telephones were provisioned as an option, typically based on the client's preference. There was however a downside to these early systems; by providing a telephone accessible to any lift passenger the specter of misuse emerged. Anecdotes abound of lift owners in the 1970s receiving huge telephone bills, only to find that an enterprising building user had been making long-distance phone calls from the lift!

The GPO had by now become 'Post Office Telecommunications' (PO) as the PSTN in the UK began the move towards privatization (eventually becoming 'British Telecom' in the 1980s). A 'Telecommunications Instruction' document (a form of work instruction) published by the PO in 1977, entitled 'Telephones in Lifts'[8], outlines how telephones would be provisioned into a lift car.

The document outlines the types of telephones to be installed and outlines the division of responsibility between the lift contractor and the PO. The lift contractor is required to:

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[4] GOODBYE TO THE HELLO GIRLS: AUTOMATING THE TELEPHONE EXCHANGE, (2018) [4]

[5] Page 21 *BS 2655 Electric lifts Part 1 - General requirements* (1957)

> 'accept responsibility for the provision and maintenance of the trailing cable between the terminal blocks in the lift car and a point situated in a position agreeable to the Post Office outside of the lift shaft'[6]

The PO would then 'provide and maintain the remainder of the installation'[7]. In terms of the telephones themselves, and their encloses, Figure 1 and Figure 2 below show the two Schemes which the PO offered.

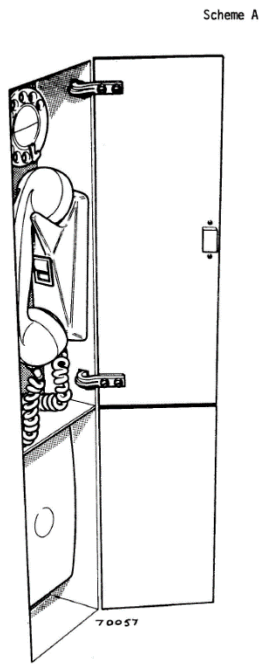

Figure 1: Scheme A

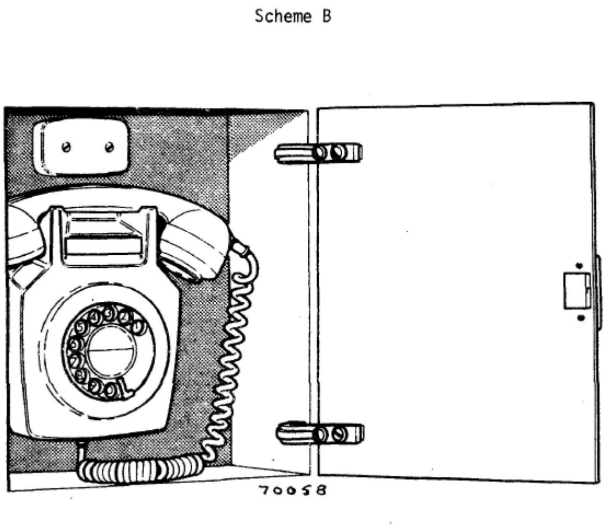

Figure 2: Scheme B

Scheme A shown in Figure 1 is described as:

> 'A 700-type pendant telephone…with vertically mounted dial and bell set. The recess may be a single continuous recess 203mm (8") wide, 533mm (21") high and 76mm (3") deep, with a door, or a recess divided 203mm (8") wide, 685mm (27") high and 76mm (3") deep divided into two compartments the upper having a door being used to house the telephone and dial unit, The lower section, covered with a removal panel, houses the bell set…'[8]

Scheme B shown in Figure 2 is described as:

> 'A 700-type wall telephone…mounted in a recess 304mm (12" square and 114mm (4 ½") deep, with a door'[9]

Regarding the recesses in the lift car required to house the telephones, the document notes that 'the lift manufacturers must agree to provide the recess in the lift car' and that 'only in exception circumstances,'[10] would anything else be considered. The PO was willing to provide the doors and removable panels.

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[6] Page 1, 'Telecommunications Instruction B4 A0005: Telephones in Lifts (1977)
[7] Page 1, 'Telecommunications Instruction B4 A0005: Telephones in Lifts (1977)
[8] Page 2, 'Telecommunications Instruction B4 A0005: Telephones in Lifts (1977)
[9] Page 3, 'Telecommunications Instruction B4 A0005: Telephones in Lifts (1977)
[10] Page 1, 'Telecommunications Instruction B4 A0005: Telephones in Lifts (1977)

5 HARMONIZED EUROPEAN STANDARDS 1979

In 1979 BSI published BS5655-1 [9]. This standard was identical to the European Committee for Standardization (CEN) standard EN81-1 and began the process of BSI publishing what at the time were referred to as harmonized European Standards (since 2019: designated standards).

BS5655-1 provided an expanded and more detailed set of requirements for what was now referred to as the 'emergency alarm device'.

> '14.2.3 Emergency Alarm Device
>
> > 14.2.3.1 In order to call for outside assistance, passengers shall have available in the car an easily recognizable and accessible device for this purpose.
> >
> > 14.2.3.2 The power for this device shall be either from the emergency lighting supply called for in 8.17.3 or from an equivalent supply.
> >
> > 14.2.3.3 This device shall take the form of a bell, intercom system, external telephone or similar device.
> >
> > NOTE In the case of connection to a public telephone network 14.2.3.2 does not apply.
> >
> > 14.2.3.4 The organization within the building should be such that it can respond effectively without undue delay to emergency calls.
> >
> > 14.2.3.5 An intercom system, or similar device, powered by the emergency supply referred to in 8.17.3, shall be installed between the car and the machine room if the lift travel exceeds 30 m.'[11]

We still have the option of an alarm bell or 'external telephone', but these are now joined by the option for an intercom.

An intercom is a voice communication system used for communication either within buildings or between buildings over a short distance and functions independently of the PSTN[12].

The use of intercoms alleviated the risk of passengers misusing a telephone, whilst still allowing two-way voice communications. The downside was the need to have another person at the other end of the system, usually on-site, to answer the call. Intercom systems are still used today in buildings which have full-time reception or security staff.

Arguably the biggest addition in BS5655-1:1979 was the requirement for an emergency power supply (14.2.3.2 above). This is interesting for two reasons:

Firstly, we're given the option of supplying the alarm device from the same emergency supply as the lighting. At the time BS5655-1 required 'an automatically rechargeable emergency supply…capable of feeding at last a 1Watt lamps for 1 h'[13] in the Lighting section (8.17) and noted that 'if the supply referred to…is also used to feed the emergency alarm signal…its capacity shall be rated accordingly'[14]. Many lift engineers who started their apprenticeships in the 1980s/90s recall being taught to connect lift alarms to the car lighting supply because of this emergency backup. Years later this ingrained practice would lead to problems as energy-saving measures were introduced whereby

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[11] Page 43, *BS5655 Lifts and service lifts – Part 1 Safety rules for the construction and installation of electric lifts* (1979)
[12] Kim Lange, *Intercom systems — how do they work?* (2017) [10]
[13] Page 22, *BS5655 Lifts and service lifts – Part 1 Safety rules for the construction and installation of electric lifts* (1979)
[14] Page 22, *BS5655 Lifts and service lifts – Part 1 Safety rules for the construction and installation of electric lifts* (1979)

the car lightning would power down when the lift was not in use. This led to a paradoxical situation in that lift alarms had been connected to the car lighting supply because it had an emergency backup, but that same supply would cut out when the lift was idle during normal operation!

The second interesting part is the note stating that requirement 14.2.3.2 does not apply if the alarm is connected to the PSTN. Here we come back to the point made above about the PSTN having its own power autonomy. A telephone in a lift car, like all telephones at the time, would have drawn its power from the PSTN telephone line to which it was connected. As the PSTN ‘line power’ was separated from the mains power grid, there was no need for a secondary power supply as part of the lift installation. If the mains power failed and a lift entrapment occurred, the passenger could still use a telephone to call for help.

In the 1980s designs of lift alarms began to emerge that finally solved the dual problems of misuse of telephones and of how a trapped passenger would know who to call. Automatic dialling systems (commonly referred to as autodiallers) began to be adapted for use in lifts.

The great benefit of autodiallers was that the system could be pre-programmed to call a specific telephone number and only needed a single button to be pressed to begin its dialling sequence. Alternatively, autodialler systems could be configured to dial once a telephone handset had been lifted from its cradle.

Autodialler equipment could also be further integrated within the lift itself. Systems such as the Kone KoneXion and the Otis Remote Elevator Monitor (REM) provided both fully integrated emergency alarm device functionality and used the telephone line to transfer lift status information.

6 LIFTS REGULATIONS 1997 AND EN81 PART 28

The close of the century also saw the signing into law of The Lifts Regulations 1997 [11]. This statutory instrument included the following requirements for any lifts being placed into the UK:

> 4 OTHER HAZARDS
>
> (4.5) Cars must be fitted with two-way means of communication allowing permanent contact with a rescue service.[15]
>
> ...
>
> (4.9) The means of communication referred to in Section 4.5 and the emergency lighting referred to in Section 4.8 must be designed and constructed so as to function even without the normal power supply. Their period of operation should be long enough to allow normal operation of the rescue procedure.[16]

The following year the updated version of BS EN81-1 [12] was published providing much-needed detail on the ‘two-way means of communication’ alluded to in the Lifts Regulations:

> 14.2.3 Emergency alarm device
>
> 14.2.3.1 In order to call for outside assistance, passengers shall have available in the car an easily recognizable and accessible device for this purpose.

[15] Page 16 *The Lifts Regulations 1997*
[16] Page 17 *The Lifts Regulations 1997*

14.2.3.2 The power for this device shall be either from the emergency lighting supply called for in 8.17.3 or from an equivalent supply.

NOTE In the case of connection to a public telephone network 14.2.3.2 does not apply

14.2.3.3 This device shall allow a two-way voice communication allowing permanent contact with a rescue service. After initiation of the communication system no further action of the trapped person shall be necessary.

14.2.3.4 An intercom system, or similar device, powered by the emergency supply referred to in 8.17.3, shall be installed between the car and the machine room if the lift travel exceeds 30 m.

The age of the alarm bell was over and now systems had to support two-way *voice* communication (14.2.3.3 above).

Five years later the dedicated lift alarm standard BS EN81-28 [13] would be published. This 18-page document laid out detailed requirements for a two-way voice alarm system. Whilst too detailed to explore at length here, BS EN81-28 included two key changes: backup power and an automatic test call.

A backup power supply now had to be included in the design of the alarm system itself, supporting a minimum of one hour of operation, and this requirement applied even if the alarm system was connected to the PSTN. Autodiallers now typically had their own on-board batteries. Unfortunately, the previous industry practice of wiring to the lighting supply, drilled into apprentices for the proceeding 24 years, again came back to haunt the industry as batteries ran flat if the lighting supply powered down when in "eco-mode".

For the first time alarm systems also had to place an automatic test call at least every three days to prove the system was operational. The question is often asked "why three days?" and the answer is somewhat macabre: a human being can survive for three days without drinkable water[17]. The idea being that if a passenger became trapped and the autodialler was not working, the passenger would have to wait a maximum of three days before help arrived in the form of someone coming to investigate the fault. Another stark reminder that whilst the risk to a passenger's safety whilst trapped in a lift is low, that risk increases over time.

Handling of these automatic test calls posed an interesting challenge for manufacturers of alarm systems. The final system that was adopted was to have the autodialler place a voice call to a modem to connect to a piece of software called a 'receiver'. The receiver software would log the test call and then communicate a confirmation back to the autodialler that the call had been logged successfully. All of the machine-to-machine communication was accomplished using Dual Tone Multi-Frequency (DTMF) signalling.

DTMF was originally developed in the 1960s and is often better known by the term 'touch tone'. Each of the twelve keys on the standard telephone keypad (0-9, * and #) is assigned an audio tone which telephone systems recognize and can be configured to respond to in a certain way. Most of us are used to this system when calling services that use an automatic operator system which can direct our calls based on a certain keystroke: e.g. "Press one to speak to sales, press two to speak to accounts…". In addition to the standard twelve tones, there are a further four tones used for machine-to-machine communication: A, B, C, and D.

[17] Page 413, 'A STUDY OF DEHYDRATION BY MEANS OF BALANCE EXPERIMENTS' (1944) [14]

Early machine-to-machine communication applications in the 1970s largely adopted DTMF as their signalling method and this continued in many industrial applications until well into the 2010s, so it was a logical choice for the lift industry. As well as the automatic test calls, DTMF was also adopted for both programming autodiallers at the point of installation and sending 'operator commands' during calls. Operator commands allow the person on the receiving end of a call to use their keypad to trigger certain actions at the other end; the most common example tends to be triggering a location message from the autodialler to help establish the location of a trapping.

7 MOBILE AND THE END OF THE PSTN

What we would think of as the first "true" mobile phone network was launched in the UK in 1985, but experimental mobile systems had been around in the UK since the 'Post Office South Lancashire Radiophone Service' launched in 1959[18]. By the early 1990s, the first-generation (1G) networks began to give way to the Global System for Mobile Communications (GSM) second-generation (2G) networks that still exist in the UK today. This led to the widespread use of mobile phones to the point where they are now seen as an essential part of everyday life.

The lift industry was wary of adopting mobile technology and fixed telephone lines continued to reign supreme until the 2010s when companies began to experiment with installing GSM gateways instead of fixed lines. The key concerns around deploying GSMs were related to being able to connect to an acceptable strength mobile signal and to remain connected from the lift installation. The lift environment is a 'signal hostile' one, given the amount of electrical & mechanical equipment and the nature of a lift shaft within the overall construction of a building.

To begin with, GSMs were often installed as a temporary measure to get the autodialler working and allow a lift to be put into service, whilst waiting for a fixed telephone line to be installed & commissioned. Once a fixed line was in place the GSM would be removed.

This practice began to shift as it became apparent that the ongoing costs of mobile SIM card contracts were becoming more competitive versus the monthly line rental charges for fixed lines. Now lift companies could install a GSM and show clients a saving on their monthly communication costs. At the same time improvements in the design of GSMs and a move to SIM cards which could roam across multiple networks began to assuage the industry's concerns around mobile signal issues.

In 2018 an event of seismic proportions happened: BT Openreach announced that the PSTN would be closed by the end of 2025. BT Openreach is the latest private company to inherit the original infrastructure, and legacy, established by the GPO following multiple rounds of privatization in the 1970-90s.

After 140 years it was deemed that the PSTN could no longer meet the changing needs of the UK and specifically could not support fast enough internet speeds. Therefore, the decision was taken to replace the existing analogue copper telephone line infrastructure with a fully digital fibre optic-based system. In practice, this process had been underway since the late 1990s but the announcement of the 'Full Fibre' programme signalled a definitive end to the PSTN.

Autodiallers, and earlier forms of lift alarms, have relied on key features of the PSTN as mentioned above, so the move to a fully digital world presents an unprecedented challenge. The end of the PSTN means the end of DTMF signalling and the loss of power autonomy for telephone lines. This means that in 2025 the industry will have to intervene to ensure lift alarms across the UK continue to function.

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[18] 'Car radiophone paved way for mobiles' (2009) [15]

8 CONCLUSION: LIFT ALARMS IN A CHANGING LANDSCAPE

At the time of writing, we are 89 years on from the publication of the 1935 Code of Practice and 21 years since the publication of BS EN81-28. During that period the telecommunications landscape in the UK has remained relatively unchanged allowing the design of lift alarms to progress steadily. The demise of the PSTN (now scheduled for January 2027) and the possibility of the 2G mobile network being removed sometime between 2026-2028 means the industry will now need to navigate much shorter technology horizons to keep pace with a telecommunication infrastructure that is rapidly re-inventing itself to keep pace with consumer needs. Innovation will be needed in the design and implementation of lift alarms and care will have to be taken to ensure the existing lift alarm base can be kept in service for the time when a passenger might most need them.

ACKNOWLEDGEMENTS

The author would like to acknowledge the very kind contributions of the following individuals who gave up their time to share their industry experience and insight as part of the research for this paper:

Gordon Lucas

Kevin McNulty

Neil Warby

REFERENCES

[1] Building Industries National Council, *Code of Practice for the Installation of Lifts and Escalators*, London (1935)

[2] Lee E Gray, *The 1935 Code of Practice for the Installation of Lifts and Escalators*, Proceedings of the 6th Symposium on Lift and Escalator Technologies, Northampton (2016)

[3] Building Industries National Council, *Code of Practice Electric Passenger and Goods Lifts and Escalators*, London (1943)

[4] Science Museum, *GOODBYE TO THE HELLO GIRLS: AUTOMATING THE TELEPHONE EXCHANGE*, available form: https://www.sciencemuseum.org.uk/objects-and-stories/goodbye-hello-girls-automating-telephone-exchange, London (2018)

[5] British Standards Institute, *BS 2655 Electric lifts Part 1 - General requirements*, London (1957)

[6] British Standards Institute, *BS2655 Specification for lifts, escalators, passenger conveyors and paternosters – Part 1 General requirements for electric lifts*, London (1958)

[7] British Standards Institute, *BS2655 Specification for lifts, escalators, passenger conveyors and paternosters – Part 1 General requirements for electric lifts*, London (1970)

[8] Post Office Telecommunications, ‘Telecommunications Instruction B4 A0005: Telephones in Lifts’, London (1977)

[9] British Standards Institute, *BS5655 Lifts and service lifts – Part 1 Safety rules for the construction and installation of electric lifts*, London (1979)

[10] Kim Lange, *Intercom systems — how do they work?*,.available from: https://medium.com/@kim_lange/intercom-systems-how-do-they-work-18410310c495 , Medium (2017).

[11] *The Lifts Regulations 1997*, London: HMSO

[12] British Standards Institute, *BS EN81 Safety rules for the construction and installation of lifts – Part 1 Electric lifts*, London (1998)

[13] British Standards Institute, BS EN81 *Safety rules for the construction and installation of lifts – Part 28 Remote alarm on passenger and goods passenger lift*, London (2003)

[14] D. A. K Black, R. A. McCance and W. F. Young, 'A Study of Dehydration by Means of Balance Experiments', The Journal of Physiology Volume 102 pages 406-414, Hoboken NJ (1944)

[15] BT Heritage, 'Car radiophone paved way for mobiles', available from https://web.archive.org/web/20140808055313/http://www.btplc.com/today/art91356.html, London (2009)

BIOGRAPHICAL DETAILS

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