OTP Communications and Statements re Fairness Doctrine

Important highlights:

• An undated note from Flanigan accuses CTW of not towing the company line: **"I thought that you had agreed to stay off this subject [fairness doctrine]? Can you please explain this to me."** The note is handwritten on a summary of news statements, the last of which quotes CTW as "warning newspaper publishers that **the Fairness Doctrine is a "runaway theory" that might someday be applied to them as well as broadcasters...."**

• 5/3/1972 CTW memo to Flanigan outlines his recommendation for OTP's posture on the Fairness Doctrine.

Memo says that CTW's earlier package of proposals included scrapping the fairness doctrine, saying that this upset Colson who believed that the fairness doctrine gave the admin a useful lever against the networks. Based on Colson's reaction, CTW agreed not to espouse that aspect of his proposals.

CTW says that OTP has refrained from making recommendations or criticisms re details of the fairness doctrine b/c OTP has no expertise on the myriad complexities of the issue nor does the Administration have serious policy concerns with them.

CTW says that his comments have been limited to what Dean Burch and others have said, that "the Doctrine has gotten out of hand and needs serious attention to limit and clarify it, preferably by the Commission"

CTW says that OTP staked out a firm administration position on only one issue, which was saying that the Admin was opposed to FTC's proposal to extend the Fairness Doctrine to product ads. In all other areas, OTP cautioned against the unnecessary extention of regulatory control over broadcast and advertising business and its extension to print media.

"In summary, I have gone out of my way to make clear that this Administration does not endorse removal of the Fairness Doctrine . . . ."

• 1974 CTW book review in Yale Law Journal. The authors of the reviewed book "recommend that the equal time provision and the Fairness Doctrine not be applied to [presidential] broadcasts in order to avoid legal challenges and to prevent the President from demanding more time to reply to them."

In FN 17, CTW writes **"It should be noted that this reviewer recommends abolition of the Fairness Doctrine because of the opportunities it creates for bureaucratic and political second-guessing of editorial judgments."**

DATED

(1) 8/5/1971 Scalia memo to CTW recommending that CTW criticize recent BEM and DNC Court of Appeals decision that is worse than the Fairness Doctrine in increasing governmental control of program content

(2) 8/6/1971 CTW writes (in response to an inquiry, unclear who and whether sent) position on BEM-DNC decision

(3) Week before 1/17/72 Scalia made a speech to the FCC bar association (about FD?)

(4) 1/17/72 OTP's general counsels sought law office's comments re Fairness Doctrine Rulemaking

(5) 1/22/72 Scalia wrote memo re FTC's Fairness Doctrine Filing re FCC's request for views on the applicability of the doctrine to product ads

***(6) Memo dated 1/31/1972 from OTP to Colson, Ehrlichman, Flanigan, Haldeman sets out Tom's upcoming appearance to testify before the Ervin Subcommittee re the Fairness Doctrine. Attached were a (1) Substance of Proposed Position re Fairness Doctrine and Access; (2) Current Fairness Provisions Applicable to Political Presentations; (3) Prior Political Use of the Fairness Doctrine; (4) Political Use of the New Proposals; (5) Effect on Republican Interests.

(7) 2/20/1972 CTW testified before Senate Communications subcommittee on oversight (the Ervin Committee) and discussed the issue with Chuck Colson beforehand (see 5/3/72 CTW letter to Flanigan)

(8) 2/25/72 Charles Colson memo says that "for those of you who have questioned my concern with the fairness Doctrine and its importance to us," attaching a Richmond News Leader article dated 2/5/72.

(9) 3/3/72 CTW wrote memo to Chuck Colson re article Chuck sent him re political uses of FCC's "fairness doctrine" and the WH position on repeal or modification of the Communication's Act equal time provision. Letter says that 3 underlying assumptions of the article that potentially support the idea that the Administration is benefited by FD enforcement are incorrect

Letter says that "OTP is not proposing to eliminate the fairness obligation, just to eliminate case-by-case enforcement of it against licensees. This would give the private licensees more discretion in meeting their fairness obligations and would cut back on second-guessing by the FCC and the courts."

"With a few exceptions [court decisions on FCC fairness doctrine rulings] are contrary to Republican interests. . . . [And] they may get even worse unless the vehicle which brings them forth-the present case-by-case method of enforcing fairness-is eliminated. It is

therefore desirable to remove as much of the power as possible from the courts and return it to the discretion of the private broadcast licensees."

***(10) 3/5/72 Washington Post article "Nixon's Top Radio-TV Adviser Would Drop Fairness Doctrine"

***(11) 3/6/72 Colson Memo attaching ____ (Eyes Only).

***(12) 3/9/72 CTW memo to Colson replying to his 3/6 memo re Washington Post article, responding to his interpretation of the article and requesting comments on CTW's 1/31/72 memo.

(13) 3/17/1972 FCC confirms that Scalia will participate as Fairness Inquiry Panelist 3/28/72.

Letter says that FCC hopes "that such an open forum for the discussion of contrasting views and opinions will materially assist the Commission in its determination of appropriate policies with respect to the Fairness Doctrine." Letter includes FCC's "Notice of Inquiry in Docket 19260" and "recent Order."

(14) 5/3/1972 CTW memo to Flanigan outlines his recommendation for OTP's posture on the Fairness Doctrine.

Memo says that CTW's earlier package of proposals included scrapping the fairness doctrine, saying that this upset Colson who believed that the fairness doctrine gave the admin a useful lever against the networks. Based on Colson's reaction, CTW agreed not to espouse that aspect of his proposals.

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"In summary, I have gone out of my way to make clear that this Administration does not endorse removal of the Fairness Doctrine . . . ."

(15) 1974 CTW book review in Yale Law Journal. The authors of the reviewed book "recommend that the equal time provision and the Fairness Doctrine not be applied to [presidential] broadcasts in order to avoid legal challenges and to prevent the President from demanding more time to reply to them."

In FN 17, CTW writes "It should be noted that this reviewer recommends abolition of the Fairness Doctrine because of the opportunities it creates for bureaucratic and political second-guessing of editorial judgments."

"Even if the television news departments of the three national networks failed to provide such extensive coverage of Congress . . . the Federal Communications Commission's Fairness Doctrine would provide a regulatory check on presidential television." [Statement doesn't support existence of the FD, just acknowledges that the FD exists and what its effect is]

"The authors also suggest that the congressional coverage under their proposal be exempt from the Fairness Doctrine. If the President and the congressional majority were of the same party, the President's opponents would not be represented by the televised congressional sessions, and they would lose the opportunity under the Fairness Doctrine to have these programs balanced by presentation of conflicting views. Moreover, if a broadcaster in this situation voluntarily attempted to balance the exempt congressional coverage by giving time to opponents of the President, there would be a danger that supporters of the President's policies might try to apply the fairness doctrine to this nonexempt coverage, forcing the broadcaster to give still more time to the presidential position."

FN 44 says that the shift of Fairness Doctrine enforcement to the "case-by-case and issue-by-issue implementation" "has made the Fairness Doctrine [the type of] mechanism that the Court [said] would regiment broadcasters to the detriment of the First Amendment."

(16) 7/2/1974 CTW letter to Senate Commerce Cttee Chair urging the Committee to report unfavorably on a bill that would repeal the "equal opportunities" requirement of the Communications Act of 1934 because it is only limited to Presidential and VP candidates instead of candidates for all federal offices.

UNDATED

(1) An undated OTP document outlines OTP's position on the Fairness Doctrine. It says that the recent shift to case-by-case enforcement should be replaced. "Ultimately fairness should be enforced through obligation during overall programming time, reviewed at license time, and through right of access by individuals during ad time. (Two separate claims or kinds of legitimate intereests, therefore two sets of mechanisms.)"

Says that industry reaction to OTP's position is that IRTS and Indianapolis speeches are inconsistent.

Date of document is post-February, 1972 and the Fairness Doctrine Inquiry, Docket 19260 was pending at the time.

(2) An undated OTP document shows that Scalia was one of nine panelists speaking about the Fairness Doctrine at some type of event.

(3) An undated timeline prepared by Eva includes several dates for which we have no documents. See dated documents below marked with asterisks.***

(4) Undated note from Flanigan challenging CTW that: "I thought that you had agreed to stay off this subject [fairness doctrine]? Can you please explain this to me." The note is handwritten on a summary of news statements, the last of which quotes CTW as "warning newspaper publishers that the Fairness Doctrine is a "runaway theory" that might someday be applied to them as well as broadcasters...."

(5) A document from 1972 or later titled "Fairness Doctrine" lists two pages of quotes about fairness from the 1949 FCC Report on Editorializing by Licensees. The third page is titled "Trouble Spots and Questions," and seems to be a list of questions for OTP to ask re renewing a broadcasting bill.

(6) A document from 1974 or later includes a table of contents on the first page, followed by a "summary chronology" of important events re: the doctrine. None of the other sections described on the table of contents are included.

OFFICE OF TELECOMMUNICATIONS POLICY
EXECUTIVE OFFICE OF THE PRESIDENT
WASHINGTON, D.C. 20504

January 22, 1972

MEMORANDUM FOR JAMES B. LOKEN

FROM: Antonin Scalia

SUBJECT: FTC Fairness Doctrine Filing

As part of its broad inquiry into the Fairness Doctrine, the Federal Communications Commission (FCC) requested views on the applicability of the Doctrine to product advertisements. The Federal Trade Commission (FTC) took the unusual step of filing in another agency's proceeding to propose a concept of "counter-advertising," which would provide a right of broadcast access for the presentation of views contrary to those raised explicitly and implicitly by product ads.

As stated fully in the attached FTC comments, the right of access would apply against all commercials--somewhat artificially categorized as follows for purposes of the FTC's suggested rules:

(1) Ad claims that explicitly raise controversial issues (e.g., an oil company ad asserting the Alaska pipeline will not harm the environment);

(2) Ads stressing broad, recurring themes in a manner that implicitly raise such issues (e.g., "food ads which may be viewed as encouraging poor nutritional habits");

(3) Ad claims that are supported by scientific premises that are subject to controversy within the "scientific community" (e.g., "a detergent or household cleanser may be advertised as capable of handling different kinds of cleaning problems"); and

(4) Ads that are silent about the negative aspects of the products (e.g., "in response to advertising for some foods, emphasizing various nutritional values and benefits, the public might be informed of the views of some people that consumption of some other food may be a superior source of the same nutritional values and benefits").

The FTC suggests that this right of access be implemented by FCC rules placing an affirmative obligation on broadcast licensees to promote effective use of counter-ads, to provide a right to purchase time for any advertising or counter-ad purpose, and to require "a substantial amount" of free time "for persons and groups that wish to respond" to ads.

By way of background, since 1961 the FTC and the FCC have had a formal liaison agreement dividing agency responsibility for guarding against deceptive broadcast advertising. The FCC requires that, as part of a licensee's responsibility for the content of all material aired over his station, the broadcaster exercise reasonable diligence in preventing the broadcast of deceptive ads. If the ad in question is of local origin, the FCC will take action against the licensee without invoking FTC processes. If the ad is of national origin, the FCC will defer to the FTC's jurisdiction, and in most cases the FTC's sanctions will be imposed on the advertiser and the advertising agency, but not on the broadcaster.

These procedures have not been used to deal with either institutional or product ads that explicitly or implicitly raise controversial issues. Under the Fairness Doctrine, as it has been developed by the FCC and the courts since the early cigarette advertising rulings, broadcasters must provide reasonable opportunity for the presentation of contrasting views when one side of a "controversial issue of public importance" is treated in an ad. In this respect, the FTC's proposal would not change existing practices--although it gives them additional respectability at a time when Dean Burch may be trying to withdraw from them. (Moreover, it may be going further than the present practice in implying that the broadcaster cannot himself meet his fairness obligations in his programming, but must affirmatively seek out advocates for contrasting viewpoints and provide them with air time.)

It is with respect to the two remaining categories of ads (i.e., those involving controversies within the scientific community and those that are silent as to negative aspects) that the FTC goes over the edge. Although acknowledging that any advertiser who falsely implies that a scientific claim is well-established would probably be guilty of deceptive advertising and hence reachable by ordinary FTC procedures, the FTC asserts that counter-ads are a "more effective" means of dealing with the problem. Likewise with respect to the advertiser's failure to disclose "negative aspects" of his product: It is "more efficient and more effective" to have the FCC deal with these deceptions through compulsory counter-advertising. In effect, the FTC is saying that the FCC, through

its oversight of broadcast content, is better able to achieve the regulatory goals that the FTC was established to serve. No doubt. The FCC holds the very existence of the broadcaster in its hands, and can achieve compliance with its wishes by the mere raising of an eyebrow. The FTC, on the other hand, is constrained by all sorts of inconvenient procedural "safeguards" when it seeks to take action against the deceptive practices declared unlawful. (The Justice Department has the same problem--and seeks the same solution: Do it through the FCC.)

What is most upsetting about the FTC filing, however, is not its understandable abdication of the difficult responsibility to make factual determinations concerning deception. Rather, it is what I would describe as the dilettantish nature and irresponsible flavor of its specific proposals, in the best Ralph Nader-Tracy Westen tradition. To appreciate this, you must read the Statement itself. Although acknowledging that the FCC "does not possess the expertise to speak definitively on this point," the Statement concludes, in less than three pages and with no hard substantiation of the point, that the proposals "are workable"--as though this were a minor detail. But the true spirit of utter obliviousness to practicality can best be derived from page 18, where, after listing five examples of situations in which counter-ads could be required to point up "negative aspects" of advertised products--examples related to products which alone account for about 40% of all TV advertising--the Statement confidently asserts that "the list of examples could go on indefinitely." It apparently did not occur to the FTC that that is precisely the problem. The same devil-may-care attitude was displayed by Mr. Pitofsky (FTC Director of Consumer Protection) in his response to press inquiry concerning who would establish the validity of the counter-ads, which might of course be produced by irresponsible and uninformed groups (Quis custodiet custodes?): As though this were a novel problem not completely thought through, he replied that the FTC "might" have to monitor them to be sure they did not involve false or deceptive statements--although this could become "ticklish," since there might be a First Amendment problem involved. Indeed.

It is possible that the FTC's proposals would devastate the broadcasting and advertising industries--without even having the welcome effect of reducing the number of TV ads, but on the contrary increasing them by some indeterminate factor. In my view, however, the real damage that has been done by the filing consists not in the creation of any substantial possibility that the proposals will be adopted--for they have been put forward before by various groups, and the FCC is

not receptive to them. The damage rather consists of the association of this Administration ("the Republican FTC") with a scheme that is viewed as not merely harmful, but downright irresponsible, by broadcasters and major advertisers. Even if there is virtually no possibility that the proposals will be adopted, it is embarrassing to the President to be indirectly associated with them, and we should make as much of an effort as possible to disclaim any connection.

(3)

As to the most appropriate means of achieving this: Neither an OTP filing in the Fairness Doctrine docket, nor a formal letter from Tom to Dean Burch seems appropriate. Both of these devices serve to give added stature to the FTC proposals. Moreover, using such procedures for a matter of this substantive triviality will diminish their effectiveness on future occasions. Unless we are willing to tell the FCC what it should do, I do not think we should debase the filing or formal-letter procedures by using them merely to criticize one possible alternative.

One feasible approach might be a letter from Tom to Miles Kirkpatrick, expressing the Administration's concern about the effects of the FTC proposal, and asking the Commission to reconsider its position. It is unlikely that this would achieve any reconsideration, but it would certainly separate us from the FTC in the clearest possible fashion. Another approach might be a planted question at Tom's appearance before the Ervin Committee on February 2. That would certainly achieve visibility, but the subject matter is really not of the same cloth as the broad First Amendment problems the Committee is considering. Finally, there is the possibility of Tom's making a detailed criticism of the FTC proposal in a major speech. He has a speech scheduled for the middle of next month which would be an appropriate occasion.

As soon as you have had a chance to digest this memorandum, I would like to discuss the various alternatives with you. Please give me a call when you are ready.

Attachment

sanctity of the home
monopoly
to operate
people's

racial eyebrow

price control
benefit one co at expense of another
1959 – ~~§~~ 315(a) bar shall apply..."
DC Cir 86 Bob Sullivan, — dissenting
67 ~~and~~ personal attack
political editorializing
71 community needs & lic renewal
67 ~~Statute~~ Bill voted

3:15

Bill Roy
FCC
for
FD
NBC

Am Marconi merger 11/99
Danielian 107

First pres AT&T 1901–
Vail offered, declined Danielian 71

AT&T organized NY corp'n 1885 – Mass or NY law
Stehman 33

Ans Bell difficulties raising capital under Mass law
Stehman 40–

Network effects in op co's & LD
Stehman 42

Rates in '90s in US lyth than Eur
Stehman 49

Bell needed capital when patents expired
Stehman 41, 59

Capital problems leading to NY '94–"
Stehman 59, 62, 63

Moving to NY
Stehman 73–

No mean. state or local, toward regulation 93-99
Stehman 96

Competition 194– Σ Stehman
Stehman 94

Old Colony, Kinsley, Erie
Stehman 100–

State reg – little prior to '07
Stehman 19

Early franchise fees rel to city govts
Stehm 119-120

Bell & public interest - poor - abuse of power
Stehm 121

Vail ~~policies~~ policies '07
Stehm 124-25

Vail support of govt reg 1912
Stehm 125

Expansion & influence / ATT 07-17
Stehm 127

Aftermath of WW
Stehm 148-149

Vail & One Man's Life

Vail b 7/16/45 Ohio p 7

Telegraph op NY 1864 p 17-18

Mail clerk 1869 – Iowa, Wyoming pp 41–
Union Pacific

Mail clerks, ee's generally not highly paid 56
(Why Vail there?)

1873 moved from Omaha to DC to open
railway mail. p 57

Detailed distance chart, 10K connections
~~state~~ by ~~state~~ (59)

1874 Asst Gen Superintendent, PO Dept.

1875 "The Fast Mail" NY–Chi fastest train!
press ~~stories~~, p 77

1876 Gen Sup Railway Mail p 80

– V knew Gardiner Hubbard bec ~~of His~~
H was member Corporation Postal Co p 107

1878 – General Manager Bell Co. age 33
p 112, 115

Moved exec office to NY 124

Bell Tel Co organized by Vail 124–125

pattern of op co's confined to area 127

WU agent 1879 gave Bell $6,000, shares
in 55 cities p 138

Marconi — Wireless telegraphy —

HP Davis / Owen Young — A KDKA model — beg for public (to sell radio sets) consumer electr. line

A1 patent usage rights —

A2 ATT entry & attempted monop.

RCA

B advertising, content, programs, copyright, ..

C1 spectrum — interference, allocations

A3 mfg, tech, antsty in radio set sales.

C2 regulation, public interest, Hoover, Congress, 27 Act, GO 40,

Young Sarnoff — D networks beg., ~~NBC, CBS~~, ATT role & rates
1926 NBC — ~~Alloc~~.

3 nets.

Paley — E CBS, conceal of network model
evol of program content
34 Act FCC

— polit time

KDKA

- HPD reads adv
  - creates industrial model for comml radio beg.
    - "free" beg svc avail to public
    - mfg & sale of radio recvrs to public
      - creation of consumer electronics industry.

→ KQL Arno A. Kluge licensed in LA Nov 1921.
Jack Kluge ??

early 1922 RCA takes over sale of Western tubes & recvrs.

explosion of GE + Western stns
AT&T → networking → NBC.

351 West 1924 appear w/SW for networking.

1879 stock $50 → $350 → $1,000
parallel Gouffe (MCI? others?) p 142
→ 170 for 100 p 145
@ 6 for 1 \ $600 x 1.7
= $1020
love of luxury, lavish expenditures 148
Noise from parallel telegraph, burglar alarm wires p 161
Reg of Western Electric 1882, V idea p 163–164
1st annual rpt Amer Bell T. Co 1881 p 167
1st dividend
Growth under V 168
1885 V resigns (173) becomes Pres AT&T summer 1885
AT&T incorp 2/25/1885 @ Appeal
<E.H. Hall>
See quote of purpose p 179–180
to cover "known world"
V resigns ATT 9/19/87, John Hudson
replaces him p 181
↳ Left succeeded TV as GM Bell

Note: Danelian chap VII, Radio - Bell Rio
draws almost exclusively on FCC 1946 B

* Susan - do we have?

* Susan - Dwy Friedlander

1907 — Vail to ATT
— de Forest vacuum tube patent

Growth of Bell System 1885—1935
Danielson p 15

Hubbard — Fabay - Fish - Vail - Thayer - Gifford

Patents & rights

Pre WW I
lots of inventors
" " patents

WW I great impasse...

Post WW I – 1920 RCA, ATT, GE
triode mfg | patent pool

Marconi
GE
West
ATT
United Fruit

* RCA ownership / Marconi distribution?
how many shareholders?
11/20/19 GE/RCA reciprocity.
triode 7/1/20 ATT/GE : RCA & WE merge.
6/30/21 West

RCA merges w/ Am. Marconi

P 185

Communications Policymaking Historical Developments Memorandum

Re: Reviewing the Gerald Ford Years.

Introduction

When Gerald Ford was President, nearly all parts of the U.S. communications business were in some significant regulatory -- and, maybe even commercial -- turmoil.

Telephone Industry Competition

The FCC had authorized limited competition in the interstate "private line" telephone business -- then legally challenged MCI Communications twice when the firm's "Execunet" offering strayed over what the FCC regarded as the proper competitive line. In 1976, however, the D.C. Circuit handed down the first of two rulings which essentially opened all the interstate long-distance business to competition. Needless to say, that precipitated a flurry of competitive entrants. Not to mention legislative excitement (ourselves, we liked the senior AT&T witness who compared the very small, nascent MCI to a "baby elephant -- "They're small now, but eventually they grow up and push you out of your house").

Under Chairman Richard Wiley and Common Carrier Bureau Chief Walter Hinchman, the FCC had also begun systematically opening the "customer premises [terminal] equipment" (CPE) business to competition. True, this remained the era of "protective couplings" and other limitations, a tribute to Hush-a-Phone's dread "blasting effect." Customers were still required to register their answering machines with the phone company (that tariff requirement may well still exist).

Finally, in 1976-77, however, the FCC instituted an equipment registration program which burst the equipment monopoly so long enjoyed by AT&T's Western Electric and other phone companies. That

initiative also opened the door to a flood of low-cost Asian equipment imports.

Television: Renewal and Other "Chaos"

Television license renewal procedures remained in turmoil, too. The Ford years were a time when many petitions to deny were filed (Federal appeals courts earlier having eliminated traditional "standing" requirements). Licenses were also renewed every three years, and there remained a "Fairness Doctrine." Additionally, the Ford years were a time when the FCC undertook to devise an extraordinary diversity of restrictions on cable television.

During the Ford years, the FCC was still enforcing its "Prime Time Access" rules, as well as arcane rules restricting TV network ownership of entertainment programming and "ancillary rights." (The antitrust actions brought by the Justice Department against the three TV networks were also well underway. They were to be settled during the Carter years, after an incoming Assistant Attorney General for Antitrust reviewed the litigation and remarked, "We sued the wrong guys!")

Back then, local TV stations couldn't run network feed during the "access hour" (7-8 PM -- actually, access half hour, because encroachment by a network news show was OK). Network affiliates also couldn't run "off-network" series or shows during the period -- they had to buy

independently produced, "syndicated" stuff (this was the basis for the "Wheel of Fortune" and other shows's success. Bob Barker and Vanna White owe a lot to the FCC of that time.)

Not infrequently, waivers from the off-network rules were sought, enabling FCC Commissioners meticulously to scrutinize particular programs and shows. The FCC determined, for instance, that Mutual of Omaha's "Wild Kingdom" qualified for a waiver -- because animal series were educational. (This was years before it was learned that Marlin Perkins and others had staged the show, tying up those gazelles, etc.) "The Living Desert" -- which had run as part of the "Wonderful World of Disney" on ABC, was OK, too. But Campbell Soup's "Lassie" didn't qualify. Though it was also an animal show, in "Lassie's" case it was a mere domestic animal, the FCC reasoned, thus less worthy of an off-network waiver.

During the Nixon Administration, FCC Chairman Dean Burch had complained about this extraordinary involvement in TV programming decisions. But the FCC still practiced it. Indeed, during the Ford Administration one FCC Commissioner regularly declared in speeches which TV shows he found particularly good -- or, bad. It was an age, in short, of "raised eyebrow" regulation which actually worked.

"You Can't Be Too Careful!"

The FCC regularly held public proceedings on various network shows and specials. In addition to scrutinizing CBS's "Selling of the Pentagon," there was the near-endless wrangling over NBC's "Hunger in America" special, and whether it was "fair." If John Chancellor or Walter Cronkite sneered, or made a face, there was apt to be at least an informal Broadcast Bureau investigation. When it comes to TV, after all, you can't be too careful was the policy, right?

There was no such thing as "talk radio," of course, and FM was still AM radio's poor relative (car companies in 1973 were to make AM/FM radios the standard, albeit extra-cost option). In Washington, WMAL's Harden & Weaver dominated morning drive-time -- and, the FCC sparked a major outcry when this super-popular duo were cited for failing to log commercial messages correctly. There was talk about introducing AM stereo, though no one was quite sure how.1 (Later, during the Carter Administration, the FCC was to propose squeezing AM stations together, by reducing the 10 Khz spacing between channels to 9 Khz, ostensibly to facilitate more minority broadcasting.)

Cable and the Growing Threat of "Siphoning"

In order to protect against "audience siphoning," the FCC restricted the number of broadcast signals which could be "imported" by cable television systems into a given market. The "anti-leap

---

1 WMAL-AM introduced AM stereo service and actually recommended that listeners get two radios, space them about 10 feet apart, and tune one to the higher part of AM 630 and the other to the lower part of that dial position. Always obedient to higher authority, your Editorial Committee tried that, but couldn't detect the delicate stereo effect. Needless to say, AM stereo passed into broadcasting history, sort of like those multicolored plastic sheets which were marketed in the 1950s to simulate color television.

frogging" rules also dictated precisely which "distant signals" could be imported, where. To protect against the companion evil of "program siphoning," moreover, there were fantastic pay cable rules.

Series such as "I Love Lucy" or "December Bride" were forbidden on cable. In the case of sports and sporting events, there were the inexplicable "highwater rules." It was a lawyer's paradise. But then, in 1976 the D.C. Circuit in its first Home Box Office pricked several regulatory boils. For FCC cable regulation, it was the beginning of the end.

The FCC continued to enforce various complicated "syndicated exclusivity" rules, however, to make sure a local TV station airing "Wheel of Fortune" wasn't challenged by a "distant" signal running the same thing. The FCC's still involved in this activity in respect of satellite television and network affiliation agreements.

"Rube Goldberg's Twin Brother"

The FCC "pervasively" regulated international communications. There was "circuit-by-circuit activation," a 50:50 balance between submarine cable and satellite circuits, and even an industry-devised and regulatorily approved "International Quota Bureau" which apportioned, for instance, any "public message telegrams" dispatched without designating a specific "international record carrier." Needless to say, international calls were very expensive. This Byzantine regulatory process was to be wooden-staked by the first reconciliation measure passed during the Reagan years.

"Ramming Speed!"

Procedurally, the FCC during the Ford years met twice, sometimes three times a week -- often nearly all day. Thus, FCC Commissioners and staff really had to "work for their keep" (someone jokingly referred to the Wiley years as comparable to that scene in Ben Hur where the Roman galley time-keeper orders "Ramming speed!") There also were seven FCC Commissioners -- and, each had an actual engineering assistant.

Congress began the process of amending the Communications Act of 1934 (GTE and AT&T, among others, distributed large notebooks declaring "The Dilemma of Telecommunications Policy"). Congress was also winding up the process of amending the 1909 Copyright Act (President Ford was to sign the 1976 amendments).

Technology Rears Its Ugly Head

During the Ford Administration, domestic satellite service began (the first provider was actually Western Union). The United States also enjoyed a significant trade surplus. Virtually all consumer electronics were North American made, moreover. Companies such as Sylvania, Magnavox, and even Motorola (the "Quasar" series) were significant television receiver manufacturers.

During the Ford Administration, the process of creating cellular radiotelephone service got underway. The Government had relinquished a large block of spectrum, Western Electric and Bell Labs developed the frequency "hand-off" approach, and the debate started over the appropriate role of wireline carriers in the field. The FCC had proceedings on whether cellular carriers should be allowed to enter and provide "fleet call" or "dispatch" services. This all seemed quite logical, back in those days.

The cutting edge office technology at the time was the IBM MagCard. The Justice Department, however, did have primordial Lanier Pcs. Toward the end of the Ford Administration, Xerox 850 word processors appeared in some Federal offices. There was no such thing as email, of course. But some agencies and offices had facsimile machines.

Regulatory Reform

Although President Ford was certainly well-acquainted with any number of communications industry personalities -- not to mention Government officials such as former FCC Commissioner Jim Quello and House Commerce Committee Chairman John Dingell -- there's no indication Ford himself paid much sustained attention to telecommunications policy. Indeed, the era's biggest single initiative -- the filing of the Justice Department's antitrust case against AT&T in November 1974 -- evidently occurred with little or no White House knowledge or input. That litigation drew much less attention than any one of the "uncommitted delegates" President Ford was inviting to dinner in 1975-76, in an effort to head off the Reagan nomination challenge.

Importantly, however, the Ford Administration did begin the process of serious, systematic regulatory review and reform -- a process which the Carter and Reagan Administrations were to continue on a strong, bipartisan basis. Civil Aeronautics Board Chairman John Robson, for instance, began allowing competitive entry in that tightly regulated field. Airlines were allowed to compete by varying their meal services, even the angle of reclining seats. On Capitol Hill, Senator Edward Kennedy and his chief regulatory reform adviser -- now U.S. Supreme Court Justice Steve Breyer -- were major airline deregulation players.

The Council of Economic Advisers (CEA) under President Ford also played a major role in this effort. CEA Member Paul MacAvoy presided over efforts to reform rail and motor carrier regulation. It may well be the last time CEA ever did anything useful.

Other Presidents had some fleeting involvement in economic regulation and its reform. President Kennedy, for instance, commissioned a survey by Harvard Dean Landis which was highly critical of economic regulation. President Johnson created the Rostow Task Force on Communications Policy (Chief Judge Posner, incidentally, was its fertile and prolific staff director). President Nixon's Ash Council recommended many changes in the overall regulatory process (they left the FCC largely unscathed, however, citing the agency's involvement in program content and political regulation).

But the Ford Administration was the first Administration in recent memory to undertake regulatory reform on a systematic, concerted basis. We think the changes which resulted are probably Ford's most important, lasting contribution: His legacy. But none of the obituaries have mentioned this commendable effort, have they?

Conclusion

In marked contrast, the Ford years weren't characterized by the strident partisanship so evident today. Both Democratic and Republican FCC Commissioners -- and, elected and appointed officials -- actually debated regulatory issues in a calm and reasonable fashion. Indeed, virtually all the regulatory reform measures begun under President Ford were pressed forward by Presidents

Carter and Reagan (a bipartisan reality which some in the Clinton Administration were surprised to learn about).

Today, much of the "regulatory Alhambra" familiar to the Ford Administration has been demolished -- and, with a steam-shovel, not merely a scalpel. But the tradition of systematically examining and eliminating unwarranted rules and regulations has attenuated, hasn't it? Nevertheless, it's possible the next Administration will again tackle these domestic policy challenges. So.

THE EARLY COMPETITIVE ERA IN TELEPHONE COMMUNICATION, 1893-1920

RICHARD GABEL*

I

INTRODUCTION

A. The Conventional View of Competition and Regulation

There is no general theory of public utility regulation. What often passes for theory is a reconstruction of historical events woven into a pattern of generalization to meet contemporary issues. Thus, while the thesis that "Regulation is the law's substitute for competition" is the legend on the wall of the Michigan Public Service Commission's hearing room,[1] there is scant evidence that those who invoke the slogan have examined the differential impact of market competition and regulated monopoly on price, market development, and innovation. While market competition provides consumers no perfect guarantee of price benefits or rapid technical and operating innovation, it creates a readier climate for such developments than does regulated monopoly. The available historical evidence indicates that, at least in the communications industry, regulation has served to stabilize price and earnings of the carriers, has inhibited innovation in rate structures, and has protected the carriers from the competitive inroads of private manufacturers and suppliers.

The possibility of introducing additional competition in the rendering of communications services has recently come to the fore. Private microwave suppliers have threatened the monopoly of the Bell System over supply of intercity toll services,[2] and the use of the computer as a switching device has offered the possibility of substitution for established common carrier services.[3]

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[1] AT&T, PROFIT, PERFORMANCE AND PROGRESS, A STUDY OF REGULATED AND NONREGULATED INDUSTRY FOR BELL SYSTEM USE 64 (1952).

[2] *See* Applications of Microwave Communications, Inc., Nos. 16509-19 (F.C.C., designated for hearing Feb. 2, 1966). Despite the opposition of AT&T and Western Union, this application was granted, FCC 69-870 (Aug. 13, 1969).

[3] Regulatory and Policy Problems Presented by the Interdependence of Computer and Communication Services and Facilities, No. 16979 (Notice of Inquiry), 7 F.C.C.2d 11, 18-19 (1966):

> "From the common carriers' standpoint, regulation should extend to all entities offering like services or to none. It is urged that the ability to compete successfully depends on the flexibility required to meet the competition, and that the carriers would be deprived of this flexibility if they alone were restricted in their pricing practices and marketing efforts by the rigidities of a tariff schedule. Thus, we are confronted with determining under what circumstances data processing, computer information, and message switching services, or any particular combination thereof—whether engaged in by established common carriers or other entities—are or should be subject to the provisions of the Communications Act."

These are just two of several developments in technology which could alter the structure of the communications industry.

Potential changes in market or regulatory structure almost invariably breed new explanations for existing conditions, or, as here, recrudescence of old ideology. Thus, in a dissent to the Report of the Presidential Task Force on Communications Policy, the Director of the Office of Telecommunications Management stated,

> Experience going back some seventy years has demonstrated that competition in the provision of local telephone service was inherently inefficient and led to poorer quality service at higher cost.[4]

The history of the period of communications competition in the United States, roughly the years 1893 to 1920, is apparently not too well known, and the view that the existence of competition in communications led to inefficiency, poorer quality, and higher cost in telephony is arrived at by a series of logical inferences which ignore the evidence that is favorable to competition. It will be the purpose of this paper to review this segment of domestic economic history and at least to question the contention raised in the preceding quotation.

B. Survey of the Competitive Era

The independent telephone industry began in 1893 with the expiration of the Bell System patents on the telephone handset. From its inception until about 1913 there was limited interconnection between the independent and the Bell exchanges. Refusal to interconnect was, of course, a tool employed in the competitive battle for domination of the industry. Interconnection refusal was not limited to the strictly duplicating situations, but was also extended to service areas where Bell had never chosen to provide telephone service. When competition took the form of overlapping exchanges of rival companies,[5] the impact on plant requirements was apparent. A subscriber desiring telephone service with access to all users was required to obtain two separate telephone instruments; a separate subscriber loop had to be furnished from each telephone instrument to a central office, necessitating separate central office lines both served by switchboard operators.[6] There clearly must have been some duplication of facilities and investment under this arrangement.

See also Irwin, *The Computer Utility: Competition or Regulation?*, 76 YALE L.J. 1299 (1967); Irwin, *Computers and Communications: The Economics of Interdependence*, in this symposium, p. 360; Dunn, *Policy Issues Presented by the Interdependence of Computer and Communications Service*, in this symposium, p. 369.

[4] PRESIDENT'S TASK FORCE ON COMMUNICATIONS POLICY, FINAL REPORT app. A, at 1 (1968) (dissent of General James O'Connell) [hereinafter cited as TASK FORCE REPORT].

[5] In 1907, overlapping territory was estimated at 20%, but this was only about one-third of all exchanges. G. JOHNSTON, SOME COMMENTS ON THE 1907 ANNUAL REPORT OF AT&T (Int'l Independent Tel. Ass'n, Sept. 1908).

[6] The duplication of subscriber directory services must have been a source of annoyance to business customers.

However, the degree of "inefficiency" and "higher cost" has never been demonstrated, and perhaps it is not determinable.

Early Bell System telephone development took place at the business core of large urban communities.[7] Since territorial extension by the competing independents was for the most part to contiguous rather than overlapping geographic areas,[8] the provision of distribution plant must have been more often complementary than duplicative. For the small central offices in use at the time there were no significant differences in cost per line for separate as against combined switching facilities, and, in the absence of interconnection, this could not have materially affected total investment.[9] Dual services, in the absence of interconnection of the rival companies at the central offices, necessarily required dual telephone instruments, but the instrument and its associated wiring probably made up less than ten per cent of the average investment per station.[10] Any rigorous examination of the effect of competition on communication costs would require knowledge of the capacity and rate of utilization of facilities prior to and subsequent to the inroads made by the independents.

A characteristic of telephone service is that it must be planned for and constructed in anticipation of future demand. A common lament of the Bell System at the time (reflected in reports to shareholders) was that its own facilities were continually inadequate to meet market demand or were not physically located where demand had developed.[11] It can be conjectured that where independents did make inroads into Bell territory and literal duplication of service areas occurred, it was largely due to either the unavailability of Bell plant or the promotional efforts and attractive pricing offered by independent operating companies.

In evaluating the charge that telephone competition engendered inefficiency, poorer quality, and higher costs, several considerations must be borne in mind. All competition involves *some* redundancy of plant facilities and work effort. The question is whether the pressure of competing market forces produces a better or cheaper product than a single supply service. The evidence is clear that under a regime of monopoly supply, during the period 1879-93, the system was stagnant. The competitive period following expiration of the Bell patents in 1893-94 resulted in the most rapid rate of growth of service in the history of the industry as well as in a substantial reduction in rates for business and residential telephone service. This comparison alone does not satisfactorily or completely answer the question whether competition was inefficient and costly. Yet with respect to the duplication

[7] 1910 AT&T ANN. REP. 23-24.

[8] JOHNSTON, *supra* note 5.

[9] In 1902 the average switchboard served 225 lines. BUREAU OF THE CENSUS, SPECIAL REPORTS—TELEPHONES AND TELEGRAPHS, table 37, at 33 (1902).

[10] Investment per station at the turn of the century was about $200. 1911 AT&T ANN. REP. 17. This source shows the average plant cost per exchange station from 1895 to 1911. The concurrent investment in station equipment is estimated at about $20 per station.

[11] 1900-07 AT&T ANN. REPS.

argument for inefficiency we see evidence of plant redundancy within the Bell System itself—duplication and triplication of exchange cable facilities, establishment of second and third wire centers within a few years of opening an initial office. Of course, this evidence may merely attest to the lack of omniscience of a highly centralized, carefully planned telephone organization. But just as Bell spokesmen would argue that a second cable on the pole line does not represent inefficiency or high cost, the independents could insist, during the competitive era, that in a period of extremely rapid growth (created by their existence) *all* facilities were efficient, necessary, and provided at reasonable cost.

The infusion of competition did force a substantial disruption of the operations of the Bell System. Profitability, rate levels and structure, and the whole innovative process were markedly affected by the coming of competition. The Bell System did not take this assault lightly. It changed tactics and practices and ultimately appealed for state intervention—the regulatory process—to stabilize and normalize competitive forces. This history is recounted below tor such light as it may shed on the relative strengths or weaknesses of competition and regulated monopoly.

II

HISTORICAL ACCOUNT[12]

A. The Period of Monopoly, 1879-93

The expiration of the basic Bell patents in 1893-94 marked the end of the System's complete monopoly over the telephone field. Since 1879 the Bell System had determined the industry's rate of expansion and the location and direction of service development as well as the charges for such service, deriving handsome profits from its efforts. At the end of 1894, equity ownership of Bell stockholders consisted of $20 million of common stock and $18 million of accumulated surplus. Of the common stock, $5 million represented the original offering (for which $500,000 in cash had been paid), while the remaining $15 million came from subsequent issues. The return on this investment was almost forty-six per cent during the period, with declared dividends averaging fifteen per cent or a total of $25 million.

Monopoly pricing had its counterpart in restricted growth. Although Bell initially contemplated the telephone for use in private line service, it soon saw the advantage of exchange service. However, high rate levels and inadequate facilities combined to prohibit rapid expansion or development. Service was provided by use of iron wire or on grounded circuits with a local battery power source[13] and was directed to customers located within a mile of the wire center. Since central offices were

[12] This section is based upon the narrative in FCC, PROPOSED REPORT, TELEPHONE INVESTIGATION pt. 2, at 134-66 (1938) [hereinafter cited as WALKER REPORT].

[13] H. CASSON, THE HISTORY OF THE TELEPHONE 168-69 (1910); BUREAU OF THE CENSUS, SPECIAL REPORTS—TELEPHONES 14 (1907).

usually located in the center of a large urban community's business-industrial area, residential, suburban, and rural service went largely undeveloped.

Public relations were usually ignored during the patent monopoly period while the System concentrated on reaping large profits. As later assessed by the FCC, "the System's attitude toward the public was characterized by arrogance and indifference."[14]

B. The Competitive Period: Development of Service

Although its patent monopoly enabled Bell to obtain franchises and establish service in the most lucrative, populous sections of the country, numerous independent telephone companies and manufacturers were formed following the expiration of these patents. While these concerns concentrated their efforts on regions not yet reached by the Bell System, they also offered competing services in many areas already served by Bell. Thus a major effect of the advent of telephone competition was the stimulation and growth of telephone service. An abbreviated summary of this development over the period 1876-1920 is shown in Table 1.

TABLE 1
TOTAL TELEPHONES IN U.S. AT DECEMBER 31 AT FOUR-YEAR INTERVALS, 1876-1920

Year	Total Telephones	Year	Total Telephones
1876	2,593	1900	1,355,911
1880	47,880	1904	3,353,247
1884	147,715	1908	6,483,629
1888	194,966	1912	8,954,936
1892	260,795	1916	11,241,432
1896	404,301	1920	13,411,379

Source: WALKER REPORT, table 32, at 143-44.

Perhaps a clearer image of the effect of competition on telephone development is given by a comparison of the rate of station growth during the period of patent monopoly and in the years immediately subsequent thereto. Table 2 illustrates this effect. Seventeen years after telephone communications had originated there were 266,431 stations operating—all owned by Bell. By the end of 1902, only ten years later, Bell maintained 1,317,178 stations and the independent companies owned an additional 1,053,866. The independents were able to maintain approximately this relative position until 1907, when they owned 3.0 million stations compared to 3.1 million owned by Bell.[15]

[14] WALKER REPORT, *supra* note 12, at 561. A more comprehensive discussion of the Bell System's pre-1910 public relations policies can be found in N. Long, Public Relations Policies of the Bell System, A Case Study in the Politics of Modern Industry (Ph.D. dissertation, Harvard Univ., 1937).

[15] BUREAU OF THE CENSUS, CENSUS OF ELECTRICAL INDUSTRIES—TELEPHONES (1932).

TABLE 2
ANNUAL PER CENT INCREASE IN TOTAL NUMBER OF TELEPHONE STATIONS, 1885-1905

Year	Annual Per Cent Increase in Number of Stations
Period of Patent Monopoly	
1885-94	6.3 (avg.)
Period of Competition	
1895	19.0
1897	27.4
1899	47.6
1901	32.8
1903	18.4
1905	23.1

Source: WALKER REPORT, table 32, at 143; table 33, at 151.

The rise of the independent companies resulted in a substantial amount of service competition during this period. Out of 1,051 U.S. cities with a 1902 population greater than 4,000, 1,002 had telephone facilities. The independents provided exclusive service in 137 of these and Bell in 414; the remaining 451 communities—almost half—received service from two or more companies.[16]

The growth which characterized this early competitive era was both intensive and extensive. It was intensive in that it was marked by a higher saturation of development, particularly of residential services, than had been attempted during the period of patent monopoly. It was extensive in that service was extended for the first time to suburban and rural areas. This vigorous pursuit of new markets, engaged in by Bell as well as by the independents, was greatly facilitated by substantial rate reductions bringing the telephone within the financial grasp of a larger consumer group.

In 1907 the Baker-Morgan banking interests gained control of the Bell System and replaced President Frederick Fish with Theodore Vail.[17] Vail substantially reversed a number of Bell policies, emphasizing absorption of the competition in preference to the earlier policy of expansion of Bell-constructed facilities. This change in emphasis resulted in a rapid diminution in the independents' proportion of total industry telephones. The decline continued until the independents' share reached its present ratio of about fifteen per cent.[18]

C. The Competitive Period: Rates

As competition increased, the rates Bell had charged during the patent monopoly period decreased significantly. Average revenue per Bell station dropped from $88

[16] BUREAU OF THE CENSUS, SPECIAL REPORTS—TELEPHONES AND TELEGRAPHS (1902).

[17] WALKER REPORT, *supra* note 12, at 101-02.

[18] As of December 31, 1968, the Bell System had 87 million telephones, while independent companies served 17 million.

TABLE 3
COMPARISON OF ANNUAL EXCHANGE RATES FOR BELL EXCHANGES WITH AND WITHOUT COMPETITION, 1894-1909

	1894	1909	
	Bell	Bell	Independents
Exchanges Without Competition			
Business Service	68.10	36.00	N.App.
Residential Service	56.00	23.75	N.App.
Exchanges With Competition			
Business Service	78.65	41.25	37.15
Residential Service	65.00	22.80	23.25

Source: 1909 AT&T ANN. REP. 25 (chart), 28.

in 1895, the first year of competition, to $43 in 1907. This effect on Bell System rates was not limited to those exchanges facing direct competition; the same benefit was also extended to patrons in areas where Bell retained exclusive service. As shown in Table 3, these rate reductions were about the same in exchange areas without competition as in those served by other exchanges in addition to Bell. President Vail used this evidence to argue that it was not the competitive forces which were leading to price reduction but cost savings initiated by the company.[19] As there is no evidence of comparable performance during the period of patent monopoly,[20] this turns the question slightly. Absent market competition, what incentive did the System have to generate cost economies?

D. The Competitive Period: Development of the Art

During the period of the Bell monopoly, the technical activities of the company were not primarily concerned with, nor organized for, development of the art through its own forces. Rather, effort was directed toward purchasing patents for the purpose of extending company control in the field of telephony. Prior to 1907 little or no attention was given by the Bell System to what came to be known as "fundamental research."[21]

The major developments in the art, up to this point, originated outside the Bell System. The Strowger switch, which made possible the advent of automatic telephony, was invented by an undertaker and manufactured by several of the independent manufacturers,[22] while the use of dial telephone service was actually resisted by Bell leadership.[23] The loading coil was developed by Professor Pupin of Columbia

[19] 1910 AT&T ANN. REP. 25-29.
[20] WALKER REPORT, *supra* note 12, at 203, 243-50.
[21] *Id.* at 207.
[22] *Id.* at 300.
[23] Theodore N. Vail in 1913 AT&T ANN. REP. 20:
"It has frequently been asserted that the Bell System did not employ automatic switchboards because of patents controlled by others. . . . [It] is not automatic for the subscriber as the subscriber does all the manipulation in the making of a connection."

University around 1905. This coil tremendously improved the quality of telephone transmission, actually making possible, for the first time, a long distance telephone system.[24] Perhaps the most significant technical development of the period—and another major innovation from outside the Bell System[25]—was Lee De Forest's development of the vacuum tube in 1914. There were numerous other developments of the art during this period, but they can be considered more as refinements of toll and exchange service than as major technical breakthroughs.

When Vail reassumed the presidency of AT&T in 1907, he shifted company emphasis from patent purchase and development to the creation of a technical and research staff capable of "occupying the field":

> One of the first things that was fully developed in our minds was the necessity of occupying the field; . . . . Just as soon as we started into the district exchange system we found out that it would develop a thousand and one little patents and inventions with which to do the business which was necessary, and that is what we wanted to control and get possession of. So from the very commencement we had our experimental department, so-called . . . whose business it was to study the patents, study the development and study these devices that either were originated by our own people or came in to us from the outside.[26]

The objective of dominating the field and asserting technical leadership in the telephonic and allied arts has served the company well down to the present day. In 1927 J. E. Otterson of the company restated and amplified the Bell System objective in the following words:

> A primary purpose of the American Telephone & Telegraph Co. is the defense and maintenance of its position in the telephone field in the United States. Undertakings and policies must be made to conform to the accomplishment of this purpose.
>
> The American Telephone & Telegraph Co. is surrounded by potentially competitive interests which may in some manner or degree intrude upon the telephone field.
>
> The problem is to prevent this intrusion.
>
> . . . .
>
> . . . [T]he best defense is to continue [research] activities in "no man's land" and to maintain such strong engineering, patent, and commercial situation in connection with these competitive activities as to always have something to trade against the accomplishment of other parties.[27]

Although it is surrounded by other industrial fields such as satellite communications and the computer application to switching and information storage, the Bell System

[24] Doherty, *The Bell System and the People Who Built It*, 46 BELL LAB. RECORD 76-83 (1968).

[25] *Id.* at 38-46; WALKER REPORT, *supra* note 12, at 415.

[26] Testimony of Theodore N. Vail, Record, vol. 2, at 1542-43, Western Union Tel. Co. v. American Bell Tel. Co., 187 Fed. 425 (1911), *reprinted in* WALKER REPORT, *supra* note 12, at 203 n.7.

[27] Memorandum by J.E. Otterson, Jan. 13, 1927, *reprinted in* WALKER REPORT, *supra* note 12, at 235-36.

now enjoys a controlling position in the field of wire telephony. The strong financial and technical resources of the Bell System, and particularly the research policy initiated by Theodore Vail, underlie its defense against any threatened invasion.

E. Airing the Dispute Over Competition

Despite the greater availability and reduced rates for telephone service, there was public criticism, particularly from the business community, of the duplicate service situations. Much of this criticism was stimulated by the Bell System, but the independents were not loath to build their own "back-fires." Theodore Vail's first annual report to stockholders, which was reproduced and widely distributed to press and public organs, treated the theme of telephone competition at length:

> Duplication of plant is a waste to the investor. Duplication of charges is a waste to the user. . . .
>
> . . . [T]he public must pay double charges, on double capital, double operating expenses and double maintenance.[28]

In two widely disseminated reports, the independents prepared a response to President Vail. They are quoted at some length to obtain the flavor of the controversy:

> Previous to 1895, when independent telephony began, it was next to impossible for a small town to get even a toll station established . . . . The style and efficiency of the transmitter was the same practically throughout the monopoly and the circuit conditions had undergone little or no change, the lines being mostly grounded circuits of iron wire . . . . Operators' service was given very little attention . . . . [T]hey failed to properly appreciate conditions peculiar to varying localities . . . .
>
> . . . [P]robably the strongest ground for complaint was exorbitant rates. . . .
>
> . . . .
>
> The very first effect of competition was a bettering of the service rendered by the Bell Company by more careful attention to operators' work, the substitution of either common return or metallic circuits for grounded lines, and, the introduction of different grades of service (party lines) by which means they offered cheaper rates with the minimum of reduction in revenue per line to themselves. . . . After these came quickly, the extension of toll lines to small places, and a marked difference in their interest in local conditions.[29]
>
> [Columbus, Ohio, is cited as an illustration of the beneficial effects of competition.] The Citizens Telephone Company [independent] began agitation for a franchise late in 1898, when the Central Union (Bell) Telephone Company had less than 1900 telephones, with rates near the business district as high as $96 a year for business telephones and $48 for residence telephones, and with additional charges for distance beyond one mile or more from the exchange. The rates throughout the city today [1908] are respectively $54 and $27 a year for Bell main line business and residence telephones. . . . At the present time each company has in the neighborhood of 12,000 [telephones] . . . .

[28] 1907 AT&T ANN. REP. 18.

[29] J. AINSWORTH & G. JOHNSTON, A DISCUSSION OF TELEPHONE COMPETITION 7-8 (Int'l Independent Tel. Ass'n, Feb. 1908).

[The author goes on to discuss the accessibility of 24,000 stations for about the same total charges as for 1900 stations ten years previously.]

. . . [Duplicate investments] are mostly in the business districts nearest the exchange, where the cable units, by reason of short lengths and the most economical sizes, are cheapest . . . .

Switchboards, if not connected, are cheaper separated than combined. . . .

Two pole lines may represent waste when they are parallel with no more of a load than could be borne on one. They may have no element of waste with a greater load, or when shared with other wire-using companies. . . .

Of the subway and conduit system only that smaller portion is waste which is represented by the costs of opening and repaving the streets . . . .

The cost of interior wiring and instruments is duplicated only in proportion to the duplication of telephones.[30]

The public airing of this controversy over the relative benefits and disadvantages of telephone competition may have had some effect on the informed public. But as in many industrial battles over markets, the most effective weapons were financial and economic. To understand this result, we must examine the Bell System response to competition.

III

BELL REACTION TO COMPETITION[31]

The loss of its patent monopoly in 1893 and the incursion of competition was followed by the Bell System with efforts to destroy or mitigate the effects of the competition. Tactics employed for this purpose during the tenure of President Fish differed markedly from those initiated by President Vail in 1907. In the early period competition was met through rapid expansion of Bell service. In the later period, 1907-20, when the Baker-Morgan financial interests had obtained control of the company, competition was allayed by purchase and absorption of independent properties. In addition to a change in method of expansion, Bell employed other devices which are discussed below in the comparison of the two eras. The change in the Bell System's rate of expansion of telephone service is shown in Table 4.

A. Early Competitive Era, 1894-1906

During the period 1894-1906 the Bell System employed a variety of methods in addition to its expansion policy in meeting the independents. Among these were (1) an active propaganda campaign; (2) refusal to connect with certain independent companies; and (3) refusual to sell telephone instruments to non-Bell companies.

1. *Bell Reprisal: Propaganda Campaign*

Bell's propaganda against the independents took many forms. Its objective was to undermine the competition's interests with the public, with bankers, with legis-

[30] JOHNSTON, *supra* note 5, at 6-8, 15-16.

[31] This section is based upon the narrative in WALKER REPORT, *supra* note 12, at 134-66.

TABLE 4
ANNUAL RATE OF GROWTH IN BELL TELEPHONE STATIONS AND PLANT INVESTMENT, 1885-1912

Period	Average Per Cent Increase in Number of Telephone Stations	Average Per Cent Increase in Plant Investment
1885-94	6.3	8.2
1895-1906	21.5	15.0
1907-12	9.6	8.5

Source: WALKER REPORT, tables 33 & 34, at 151, 152.

latures, and with present or prospective investors. This campaign appears to have had considerable success against the larger independent telephone companies. However, the smaller mutuals and independents, which grew directly out of local community needs and were less dependent on central capital markets, were apparently less affected by the propaganda efforts.

2. *Bell Reprisal: Refusal of Interconnection*

Refusal to connect with independent telephone systems for long distance telephone service afforded Bell a stronger means of curbing the independent movement. Since Bell was the pioneer in this field, its refusal to connect confined independent companies within the limits of the particular territories they served. The independents early recognized this weakness of their position, and they attempted, in 1899, to form an independent long-distance network. The extensive financing required for such an undertaking was to be organized through a consortium including the Peter Widener interest. At the request of Mr. Morgan of the banking firm, Widener withdrew as financial sponsor of the undertaking, and it collapsed shortly thereafter.[32] It it significant that the Baker-Morgan group shortly thereafter acquired the Bell properties and made them the nucleus of an even stronger communications system including both the Bell System and Western Union Telegraph Co.[33]

3. *Bell Reprisal: Refusal to Sell*

Another weapon employed by Bell against the independents was its refusal to sell telephone equipment outside the System. This encouraged the development and growth of independent telephone manufacturing concerns once the Bell patents had expired, and the three most important independent manufacturers—Kellogg Switchboard & Supply Co., Stromberg-Carlson Telephone Manufacturing Co., and Automatic Electric Co.[34]—were established during this period. The existence of the in-

[32] 69 COM. & FIN. CHRONICLE 1151 (1899).

[33] WALKER REPORT, *supra* note 12, at 99 n.14.

[34] It is interesting to note that today these three companies are subsidiaries of ITT, General Dynamics, and General Telephone, respectively.

dependent telephone manufacturing firms encouraged competitive product development. Development of automatic dial service, the supplanting of local magneto by common battery service, development of full manual multiple-operator service, and a number of refinements in relay manufacture can be traced to the efforts of independents during this period.[35] Independent innovations in harmonic ringing and signalling systems eventually led to problems of system compatibility when Bell later partially reversed its position and sought interconnection with the independents.

The refusal of the Bell System to sell telephone apparatus to independents failed to stop their competition, so Bell then attempted to acquire control of Kellogg and Stromberg-Carlson. Both attempts ultimately failed through intervention of public authorities, who had them set aside on the ground that they would create a monopoly in the manufacture of telephone equipment.

B. Late Competitive Era, 1907-20

The onset of Baker-Morgan control over the System in 1907 precipitated an abrupt change in Bell's policy toward independents. This reversal was evidenced by a reduction in the rate of Bell System internal expansion coupled with a policy of buying up independent properties. As Table 4 indicates, the average rate of growth of Bell stations in the early period of competition, 1895-1906, was 21.5 per cent; while for the years 1907-12 the annual rate of expansion dropped to 9.6 per cent.

Rapid market expansion had cost heavily in investment dollars, and rate levels were declining so fast that revenue increases lagged investment growth. In successive reports to stockholders, President Fish lamented the decreasing profitability resulting from competition:

> [I]n certain localities, rates too low to cover current expenses and necessary allowance for renewal have been offered, to meet similar rates offered by competitors.[36]

And again in 1904:

> In some places in the country, particularly where there has been the demoralizing effect of unintelligent competition, the rates are at the present time too low.[37]

In his last annual report, President Fish repeated the theme:

> [T]he unintelligent views of our competitors as to what rates for service are possible have created conditions in the portions of the country to which reference is now made, under which neither they nor the Bell companies are getting proper returns for the service rendered.[38]

President Fish's critical remarks about the "unintelligent competition" were stimulated by real events. During the period of patent monopoly, the company had

[35] T. GARY, THE STORY OF THE INDEPENDENT TELEPHONE INDUSTRY (circa 1935).
[36] 1900 AT&T ANN. REP. 10.
[37] 1904 AT&T ANN. REP. 10.
[38] 1906 AT&T ANN. REP. 12.

enjoyed an average return on investment of nearly forty-six per cent. For the competitive years 1900-06, net earnings on average net investment dropped to the vicinity of eight per cent.[39]

To meet the competition, as noted above, President Fish had initiated a program of rapid plant expansion. Between 1895 and 1905, Bell System assets nearly quadrupled, rising from $120 million to $453 million.[40] The need for what, at that time, were tremendous additional capital resources, led to control of the System by the Baker-Morgan financial interests and the replacement of Fish by Vail.[41] President Vail, in addition to slowing the rate of company expansion, introduced other major policy changes which effectively challenged the competition's advance. These policies were quite different from those of the early competitive era and are discussed under (1) policy of acquisition; (2) interconnection; (3) sales to independents; and (4) regulation.

1. *Late Competitive Era: Acquisition Policy*

With the curtailment of its own rate of internal expansion, the Bell System, beginning in 1907, launched an aggressive program of acquiring independent telephone properties. The effect of this change in policy is demonstrated by the shift in the ratio of telephones between the two segments of the industry. In 1907 the independents owned 3.0 million stations, while Bell owned 3.1 million. By 1912, there were 3.6 million independent stations and 5.1 million Bell stations.[42] The proportion of independently owned stations decreased progressively until about 1940.

Bell's acquisition attempts were strongly resisted by the independents, who made complaint to the Attorney General, George Wickersham. They were joined in charging antitrust violations by the Postal Telegraph-Mackay interests, because the Bell System had earlier succeeded in acquiring control of Western Union Telegraph Company, and the physical consolidation of Bell System and Western Union properties threatened to undercut Postal Telegraph markets.[43]

As a result of these complaints, AT&T vice-president N. C. Kingsbury met with the Attorney General and later in 1913 drafted an agreement which became known as the Kingsbury Commitment.[44] Under this agreement, the Bell System agreed not to acquire control over any competing company, and it agreed to connect its system with those owned by independents if the latter met Bell System equipment requirements. The Commitment did not restrict the Bell System from acquiring

[39] Staff Reports, Exhibit 1360-B, table 84, at 425, prepared for introduction into evidence for the WALKER REPORT, *supra* note 12.

[40] *Id.*, Exhibit 1360-A, table 7, at 52.

[41] *See* text accompanying note 17 *supra.*

[42] 1932 CENSUS, *supra* note 15.

[43] Staff Reports, *supra* note 39, Exhibit 2096-D, ch. 3. It is interesting to note that the Bell System's first attempt to unite the telephone and telegraph industries involved the Mackay-Postal Telegraph interests in preference to Western Union. WALKER REPORT, *supra* note 12, at 97-99.

[44] The Kingsbury Commitment is reproduced in 1913 AT&T ANN. REP. 24-26.

noncompeting telephone companies. Between 1913 and 1917 the Bell System purchased over 241,000 stations from the independents and sold 58,000 stations. During the war years, 1918-19, the Post Office Department assumed control over all telephone properties, and these were the only years after 1912 when the Bell System sold more stations than it acquired.

The competitive milieu created by the Kingsbury Commitment was not viable for many independents, as they were unable to dispose of their properties on favorable terms. Therefore, the independents joined Bell in seeking passage of the Willis-Graham Act of 1921, which permitted the merger or consolidation of competing telephone companies.[45] Passage of the Willis-Graham Act was construed by the Attorney General as terminating the Kingsbury Commitment, and Bell again undertook an aggressive policy of acquiring independent properties. The intensity of Bell's activity in this regard once again created apprehension among the independents. After some negotiations, the Bell System sent a letter, which became known as the Hall Memorandum, to F. B. MacKinnon, president of the United States Independent Telephone Association. Dated June 14, 1922, this correspondence stated Bell's new policy relative to acquisitions. The Bell System agreed "to make no purchases of, or consolidations with, independents unless demanded for the convenience of the public or unless special reasons existed making the transaction desirable for the protection of the general public service or Bell System property."[46] Using these two exceptions the Bell System then continued to make such acquisitions of independent properties as it desired.

2. *Late Competitive Era: Interconnection*

Until the Kingsbury Commitment was entered into in 1913, the Bell System, in varying degrees, refused to interconnect with independent exchanges for long-distance service. President Vail explained the Bell System hostility to interconnection: "Offering a connection with a so-called competing exchange . . . is offering a different service, except so far as they connect the same subscribers, and there it is of no benefit, as either one would serve the purpose."[47]

The independent telephone companies resisted interconnection as well and were active in opposing state legislation which would compel physical ties between competing telephone companies. This viewpoint was expressed by F. B. Mac-

[45] Act of June 10, 1921, ch. 20, 42 Stat. 27. The legislative history of the Willis-Graham Act is in the ICC official library. 61 CONG. REC. 1983 (1921) (remarks of Representative Winslow):

"The bill was brought to the attention of the committee by those representing a very large majority of the so-called independent telephone companies of the United States.

". . . Many of them . . . are skating on very thin ice in respect of their financial operations. . . . [T]hey have represented to the committee . . . that if the opportunity to sell or consolidate is not afforded to them they are liable to go through the condition of bankruptcy . . . ."

[46] WALKER REPORT, *supra* note 12, at 158.

[47] 1909 AT&T ANN. REP. 24.

Kinnon, president of the United States Independent Telephone Association, before a joint congressional committee as follows:

> Representative HUDDLESTON. How does it [compulsory interconnection] ruin an exchange?
> Mr. MACKINNON. If an exchange which is now operating successfully is obliged to give up its entire toll system and its connections to another exchange in the same town and which has no money invested in that toll system, it may be that that other exchange . . . can take away the subscribers of the other exchange.[48]

The successful competitor strives to become the surviving monopolist.

It is futile to reflect on what could have been. In view of the opposition by both segments of the telephone industry to interconnection of competing facilities and the general laissez-faire attitude of public authorities, the likelihood of achieving interconnection was remote. Despite the independents' inadequate financial resources (partly due to Bell pressure), had there been full interconnection during the early years of competitive rivalry, it may be hazarded that the structure of the telephone industry would have been more equally balanced. There is little question but that interconnection would have relieved subscribers of the burden of dual instruments and separate directories and lessened the public demand for forced consolidations. The Bell System watchword "Universal Service" could have been achieved without "One System, One Policy."

It may be that the extensive financial resources of the Bell System, with its banker support, would, in any event, have overwhelmed the struggling independent industry. The independents were fragmented and frequently fought as bitterly among themselves as they did against the Bell System. By the time Vail assented to interconnection with noncompeting independents, the relative decline of this segment of the industry was evident. It was a decline brought on by Bell's aggressive acquisition policy and the financial difficulties being experienced by the independents. In part, the inability of independents to secure additional capital is explained by the reluctance of bankers to finance closed systems—exchange areas without access to the outside world through toll interties. During the critical years in which the legislators might have acted, 1893-1907, the public and the companies were disinterested. Policy, in an issue of this sort, is made through the clash of competing interests. Because both segments of the industry opposed interconnection at the time, a salient opportunity was lost.

3. *Late Competitive Era: Bell Sales Policy*

As noted earlier, the refusal of the Bell System to sell telephonic equipment to non-Bell companies proved a failure as a weapon in fighting the independents. With the advent of banker control of the Bell System in 1907, this policy was

[48] *Joint Hearings on S. 1313 Before the Committees on Interstate Commerce*, 67th Cong., 1st Sess. 8 (1921).

reversed, and sales to independents and on the open market were permitted. There were several reasons for changing the company sales policy toward independents. At the time (1907), the Bell System patent situation was such that the company had almost no exclusive patent protection which would prevent independents from developing satisfactory central office, outside plant, or station equipment. The vigorous development of independent telephone manufacturers, concurrent with the growth of independent telephone operating companies, attested to this fact. By 1907 there were about as many independently owned telephone stations as Bell-owned stations. The independents constituted a sizeable prospective market for Western Electric, Bell's wholly-owned manufacturing subsidiary, and Western sought a share in this independent market in competition with the independent manufacturing firms.

In addition, there were future advantages in undertaking the sale of Bell-Western equipment to the independent operating companies. Vail had initiated a deliberate policy of acquiring independent operating properties and absorbing these into the Bell System. The installation of Bell System equipment into independent plant made for compatibility and uniformity of equipment and rendered later acquisition of such companies more attractive.[49]

4. *Late Competitive Era: Regulation*

Possibly the most significant policy reversal initiated under Vail's tenure as AT&T president was with respect to public regulation. Throughout the period of patent monopoly (1873-93) and the early years of competition (1894-1906) the Bell System opposed government intervention and regulation of the telephone business. This view was wholly consonant with the prevailing industrialist viewpoint. Bankers, however, require more stability and rationality of operations than can be evinced by a cutthroat competitive environment. President Fish was ousted and Vail reinstated as president of the Bell System by the Baker-Morgan banking groups. These large eastern banks had been key witnesses to the creation and operation of the Interstate Commerce Commission and had observed federal regulatory efforts to reduce the rail carrier intransigency which produced "price wars." The ICC was "making good" in its efforts to stabilize markets and price structures in the railroad business without invading private managerial prerogatives. Vail early saw the possibilities of effecting such normalization and stability in the telephone industry.

The opening signal of this reversal of viewpoint was the discussion of "Public Control" in the 1907 Annual Report to stockholders:

> It is contended that if there is to be no competition, there should be public control.
>
> It is not believed that there is any serious objection to such control, provided it is independent, intelligent, considerate, thorough and just, recognizing, as does

[49] This thesis is developed further in Staff Reports, *supra* note 39, Exhibit 2096-D.

the Interstate Commerce Commission in its report recently issued, that capital is entitled to its fair return, and good management or enterprise to its reward.[50]

Two years later Mr. Vail was somewhat more equivocal:

> Although there have been abuses in corporate management . . . yet it must be admitted that the tremendous development of utilities in this country as compared with other countries . . . is to a certain extent due to the lack of proscriptive restrictions.
>
> . . . .
>
> We believe that if there is to be control, there should be protection . . . . We believe that management or operation by a body without any accountable responsibility [*i.e.*, regulatory commissions] would be prejudicial to the best interests of the service and of the public, and destructive . . . .[51]

By 1910 President Bell could see the broad picture:

> It is not believed that this [integration of service] can be accomplished by separately controlled or distinct systems nor that there can be competition in the accepted sense of competition.
>
> It is believed that all this can be accomplished to the reasonable satisfaction of the public with its acquiescence, under such control and regulation as will afford the public much better service at less cost than any competition or government-owned monopoly could permanently afford . . . .
>
> . . . .
>
> . . . [T]his "supervision" should stop at "control" and "regulation" and not "manage," "operate" nor dictate what the management or operation should be . . . .
>
> . . . .
>
> If there is to be state control and regulation, there should also be state protection—protection to a corporation striving to serve the whole community . . . from aggressive competition which covers only that part which is profitable.
>
> . . . .
>
> A public utility giving good service at fair rates should not be subject to competition at unfair rates.[52]

Regulation is a two-sided coin: on one side lies the aspect of public protection—profit limitations, the obligation to provide service at nondiscriminatory rates, and so forth. The other side of the coin bears the aspect of utility protection—including bars to competitive entry, exclusive franchise, and the right of eminent domain. With an insight that was to serve Bell corporate interests well, Vail anticipated the limited inroads that public regulation would make in obtaining the first series of objectives and the extensive benefits conferred by the second. Real power would always rest with those responsible for management of telephone operations, and Vail was always insistent on the distinction between "regulation" and "management." Although the program of acquiring independent properties was being pursued unabated, the

[50] 1907 AT&T ANN. REP. 18.
[51] 1909 AT&T ANN. REP. 34, 36.
[52] 1910 AT&T ANN. REP. 23, 32, 33.

combined objective of "Universal Service—One System, One Policy" could not be achieved without political intervention. Bell's response to this limitation was the promotion of regulatory authority in utility commissions.

The Bell System objective of substituting regulation for the rigors of market competition was met. In 1910 Congress enacted the Mann-Elkins amendment to the Interstate Commerce Commission Act, a portion of which conferred regulatory authority over interstate telephone companies on the ICC.[53] Between 1910 and 1920 thirty-one states established authority for regulating intrastate operations of telephone companies.[54]

The history of the federal enactment is peculiar in that the original legislative proposal was intended solely to confer appellate jurisdiction over ICC decisions concerning railroad matters on a Commerce Court. In twenty-six parts of the hearings before the House Interstate and Foreign Commerce Committee, there is no testimony or mention of the communications industry.[55] The original bill, as reviewed by the committee, was amended on the floor of the House to confer authority on the ICC over "telephone, telegraph and cable companies."[56] Representations of the Bell System with regard to this legislation were made informally. The position of the independent industry was also favorable, as reflected in a letter from J. B. Ware, Secretary of the National Independent Telephone Association, to Senator W. Alden Smith of Michigan.[57]

It is not unlikely that the Bell System shared the view of Samuel Insull, Chicago utility executive, when he told the National Civic Federation that he preferred to "help shape the right kind of regulation than to have the wrong kind forced upon [him]."[58] With clear-minded dedication, the Bell System did "help shape the right kind of regulation." During these years it furnished legislative consultants to "help and advise" state and federal legislators and to maintain continuing liaison with regulatory commissioners and their staffs.

In the twenty-four years (1910-34) that the ICC regulated telephone companies, the Commission dealt with telephone rates in only four cases, none of which involved issues of major importance. "The Commission undertook no general rate investigations; it acted only on the basis of such complaints as were brought before it. . . .

[53] Act of June 18, 1910, ch. 309, § 7, 36 Stat. 544.

[54] H.R. REP. No. 109, 67th Cong., 1st Sess. 3-4 (1921).

[55] *Hearings on Bills Affecting Interstate Commerce Before the House Comm. on Interstate and Foreign Commerce*, 61st Cong., 2d Sess. (1910).

[56] The legislative history of the Mann-Elkins Act is filed in the ICC reference room.

[57] Letter from J.B. Ware to Senator W. Alden Smith, May 20, 1910, 45 CONG. REC. 6973-74 (1910):

"[T]he Bell interests have in spots furnished service at less than cost, and in many instances without cost for months, and . . . years . . . .

"We do not ask the Government to fight our battles, but we do ask for protection against outrageous methods of warfare which are illegal and detrimental to the public welfare. . . . We are not afraid of supervision; we believe in regulation . . . ."

[58] Letter from Ralph M. Easley to George W. Perkins, June 9, 1909, in J. WEINSTEIN, THE CORPORATE IDEAL IN THE LIBERAL STATE: 1900-1918 at 87 (1968).

In the absence of serious pressure to exert its power in the communications field, regulation went largely by default."[59]

We have the vision of hindsight. President Vail, after four years of operating under the law, enlarged upon his regulatory experience in addressing his shareholders:

> Regulation and control by commissions or business courts have . . . become a permanent feature of our economic laws. . . . The few years' experience has brought out prominently both good and bad features, but it has demonstrated . . . a satisfactory solution of the economic problems . . . .
>
> . . . .
>
> Business courts . . . will soon bring order and security out of the present uncertainty and be a bulwark against future economic disturbance.
>
> . . . .
>
> . . . [T]he Bell System has no cause for complaint, protest or criticism as to its relations with . . . commissions . . . . [R]ight and reason have been the controlling influences in the conclusions reached.[60]

IV

CONCLUSION

In a sense all business enterprise is a flight from competition. The penalties of competition—low or nonexistent profits—may be avoided by superior efficiency, by product innovation or differentiation, or by attenuation of the competitive process through control over supply and price wielded monopolistically or through conspiracy or tacit understanding with competitors. Confronted by the vigorous competitive inroads of independent operating companies, the Bell System sought to escape the unaccustomed hardships of competition by acquiring competitors, by limiting their markets and their services, and by espousing the development of governmental regulatory functions. The public service commissions, which ultimately stabilized rates and earnings, adopted the norms of business policy urged by the System and imposed strictures on the "unintelligent competition." The advantages thus gained by the Bell System over its remaining competition have been parlayed into a practically unassailable market position fortified by political and legal ramparts.

The thesis has been posed that telephone competition during the years 1893-1920 was neither inefficient nor costly but was, on the contrary, productive of benefits sharply outweighing its costs. It was not just the working out of the competitive market process toward the emergence of inevitable "natural" monopoly which destroyed the structure that permitted competition to flourish and its benefits to be enjoyed; it was as much a poorly conceived, Bell-inspired, protectionist regu-

[59] M. FAINSOD, L. GORDON, & J. PALAMOUNTAIN, GOVERNMENT AND THE AMERICAN ECONOMY 375 (3d ed. 1959).

[60] 1914 AT&T ANN. REP. 47-49.

latory policy which failed to preserve such competition as might usefully have served the public interest. This history is irreversible in that private telephone monopoly is established and institutionalized. In the absence of advocates for countervailing interests, the viewpoint of private monopoly has melded with and been espoused by public regulatory authority. The contemporary rationale for communications monopoly has not moved far ahead of Theodore Vail; the words are different, but results and objectives remain the same. In the name of "systemic integrity," "economies of scale," and "unitary planning," arguments have been made for extending the present market and regulatory structure.[61] Yet over the long run, dynamic technology may provide more effective control over communication rates and services than unaided regulation can supply. After years of experience, regulation remains unproved, but the gratifying performance of the competitive marketplace from 1893 to 1920 has been forgotten. Perhaps, if nothing else, the public presumption that regulation is necessarily inspired and informed by the public interest can be re-evaluated in the light of the history recalled above.

Revolutionary shifts in technology and aggressive innovation will be aborted if they do not receive the support of thoughtful public policy. The Presidential Task Force on Communications Policy has suggested that domestic communications satellite service be treated as a regulated monopoly.[62] The Task Force maintains that spectrum shortage and the limited number of orbital "parking slots" necessitate a single, multiple-purpose satellite system. But any policy must operate within existing technical constraints; policy making only begins at this stage. We must also consider what organizational forms will permit the greatest development of the art, the widest play of operating alternatives, and the most deliberate impetus to novel and experimental application of satellite technology. In a sense we are again at the same threshold that policy makers confronted in 1893 with the opening up of a new industry. Today, as then, policy decisions on market structure and the respective roles of competition and regulation, once made, cannot be easily reversed.

[61] TASK FORCE REPORT, *supra* note 4, ch. 6.

[62] *Id.* ch. 5. This proposal has not been favorably received by Bell System spokesmen. *See* Ashley, *International Communications: What Shape to Come?*, in this symposium, p. 417.

Perspectives on the Bell System: Strategy, Structure, Technology, and Unionism

RICHARD H. K. VIETOR

The Telephone Enterprise: The Evolution of the Bell System's Horizontal Structure, 1876–1909. **By Robert W. Garnet. (Baltimore: John Hopkins University Press, 1985. xxiii + 210 pp. $22.50.)**

The Anatomy of a Business Strategy: Bell, Western Electric, and the Origins of the American Telephone Industry. **By George David Smith. (Baltimore: Johns Hopkins University Press, 1985. xxii + 237 pp. $20.00.)**

From Invention to Innovation: Long-Distance Transmission at the Turn of the Century. **By Neil H. Wasserman. (Baltimore: Johns Hopkins University Press, 1985. xxiii + 160 pp. $17.50.)**

The Making of Telephone Unionism, 1920–1947. **By John N. Schacht. (New Brunswick, N.J.: Rutgers University Press, 1985. x + 282 pp. $30.00.)**

Divestiture of the Bell System in 1984 dramatically reversed more than a century of integration, standardization, and centralization. These factors together produced the world's largest corporation (in both assets and work force) which, guided by regulation, managed the world's largest and most effective telecommunications network. Although technology and economics drove these developments, none were inevitable or easily accomplished.

All four of the histories reviewed in this essay attest to the gradual, plodding, and often disorderly administrative efforts that produced the Bell System, the telephone network, and the Communications Workers of America (CWA). Yet, the degree of overlap among these four books is surprisingly small: in part because each study is narrowly conceived, and in part because the story itself has epic proportions. Two of the books examine top management's approach to horizontal and vertical integration. The third focuses on the process of technical innovation and its implementation by middle management. The fourth book starts from the bottom up, tracing the evolution of a centralized labor organization. While each book adds a piece to the larger history

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of telecommunications, all four are stand-alone studies, contributing to the fields of business history, technology history, and labor history.

These books share a common departure from the conventional literature, including the "Robber Baron" tradition of attacking AT&T's monopoly power (N. Danielson, H. Coon, and J. Goulden); specialized analyses of financial, economic, and social factors (J. Stehman, G. Brock, J. Brooks, and I. Pool); biographies of the industry's leaders, especially Alexander Bell and Theodore Vail (R. Bruce, C. MacKenzie, and A. Paine); and previous studies of labor relations (J. Barbash and T. Brooks) and technology (G. Prescott and M. Fagan). Either consciously or not, these authors utilize the organizational synthesis developed by Alfred D. Chandler, Jr., in *Strategy and Structure* (1962) and *The Visible Hand* (1977). For company and union alike, strategic goals and organizational structure responded to available markets and technology.

Three of the books—by Garnet, Smith, and Wasserman—are the first fruits of the Johns Hopkins–AT&T Series in Telephone History, edited by Louis Galambos. This joint endeavor, supported by AT&T's archival program, is further evidence of the business community's resurgent interest in analytical administrative history. Instead of attempting definitive business biographies, this open-ended series gives individual scholars the opportunity to examine specific themes. These first three products are appropriately short, with high-quality illustrations, appendixes, indexes, and notes. More important, all three are carefully researched in AT&T's rich archival material.

Robert Garnet's study of the Bell System's horizontal integration originated as background material for the defense in *U.S. v. AT&T.* Without being ahistorical, Garnet has provided a fascinating analysis of the origins of the horizontal structure that the Justice Department alleged to be anticompetitive. Garnet documents American Bell's humble start in 1877 (the year after Bell's great invention) as a patent association, relying for its revenues on agent licensees and equipment leasing. For its capital-short owners, this system was the easiest, and perhaps only, way to get started and grow fast, while keeping absolute control over valuable patented instruments. This was the essential strategy.

Almost from the start, however, integration seemed unavoidable, as rapid growth and intense competition with Western Union forced Bell to extend financial support to agents in their scramble to establish exchanges. At the same time, Theodore Vail, the company's first professional manager, introduced administrative organization. In 1879, the fledgling Bell Company and the giant Western Union Company agreed

not to compete, leaving voice communications (local) to Bell and telegraph (long-distance) to Western Union. This settlement, of course, was an extraordinary blunder by Western Union—the price of ignoring potential markets and focusing exclusively on existing markets.

Although this agreement eliminated competitive pressures temporarily, the impulse toward integration continued, coming from technological developments in exchanges (switching centers) and in toll (long-distance) services. AT&T, organized in 1885 as the long-distance subsidiary of American Bell, became increasingly involved in the financial and technical weaknesses of licensees. Yet throughout the 1880s, financial weakness, political opposition to excessive power, and management caution prevented any serious progress toward integration and central control.

After 1894, when Bell's patent monopoly expired, competition and chaotic growth once again forced the process of structural integration. To coordinate production and distribution of telephones, exchange equipment, and cable, and especially the movement of millions of calls, Bell managers struggled to develop internal controls over accounting, financial planning, personnel, and technical standards. Grudgingly, the tradition of local autonomy gave way to centralized management, and on the last day of the nineteenth century, the company was reorganized as American Telephone and Telegraph, a New York corporation with assets of $107 million and substantial or controlling financial interests in more than thirty regional Bell operating companies.

Several more years of intense competition, burgeoning financial obligations, and widespread political criticism culminated in a management crisis in 1907, and the return of Theodore Vail as CEO. (Vail had left AT&T in 1887 for the investment banking interests of Morgan and Baker.) Vail introduced a functional organization and a new strategy of "one system, one management, universal service." To settle antitrust allegations and end competition, AT&T agreed in 1913 to divest Western Union, to stop buying up competition, and to interconnect with the remaining independent companies. With 82 percent of market share, and virtually all long distance, the Bell System had achieved a monopoly status that would endure for seventy years.

Garnet's story of the management process that led to the horizontal integration of the Bell System is a well-researched, well-written monograph. And it delivers a fair part of what the author promises—a detailed illustration of Chandler's synthesis. But it does not deliver the analysis of political factors that the author advertises in his introduction. When the author declares, in the last substantive chapter, that

the company was "hounded by the specter of regulation and municipal ownership" (p. 128), the reader expects a substantial analysis of AT&T's competitors, AT&T's competitive tactics, and, most significantly, the regulatory movements and antitrust attacks that developed during the Progressive Era. But these forces are merely asserted, not documented or described. Then, when the author notes in the conclusion the importance of looking beyond technology and economics because AT&T was a politically salient industry unlike those studied by Chandler (p. 156), the reader probably agrees, but closes the book less satisfied than he might otherwise have been.

George Smith, in his study of vertical integration, promises less and delivers proportionately more. By vertical integration, Smith means American Bell's upstream investment in manufacturing by purchasing Western Electric and subsequently coordinating manufacturing with communications operations. This early decision, like those to lease telephones and integrate horizontally, formed the basis of a business strategy that would last for decades.

The way Smith frames the issue—as a single, key decision in 1882 that is gradually arrived at and subsequently implemented—reflects a perspective that is unfamiliar to historians; that is, neither organizational nor industrial structure are products of conspiracy, nor, for that matter, natural evolution. Businesspeople, Smith notes, are indeed averse to price competition, preferring consolidation or even cooperation. And, as Smith also shows, technological and market imperatives drove American Bell toward vertical integration (just like Garnet's horizontal integration). But the event, set in complex circumstances that Smith takes pains to describe, was an administrative decision—a strategic choice—by management.

At the heart of this book are two chapters that detail the procurement problems leading up to the acquisition and the development of the acquisition strategy itself. Smith develops the problem carefully, in Chandlerian terms. During its first two years, Bell was plagued by problems of inadequate capacity resulting from an exclusive procurement contract with a family friend. In 1879, it expanded its purchasing to four other manufacturers, taking care to protect its patents. Although bottlenecks eased, new problems developed with quality, differential prices, regional purchasing imbalances, and, finally, competition to serve independent licensees.

In an effort to consolidate sourcing, to achieve economies of scale, and to impose standard designs, while still maintaining adequate capacity, Bell finally purchased Western Electric, the nation's largest producer of electronic equipment. Smith makes a strong case that Bell

managers had more in mind than resolving problems with suppliers. According to Smith, the decision reflects a broader concept of the telecommunications business, anticipating the expiration of its patent monopoly (and thus the need to prevent the preeminent manufacturing firm from falling to competitors), and an interconnected network of local exchanges that would require uniform technical standards, greater cash flow (from manufacturing revenues), and market dominance. Smith credits William Forbes, president of American Bell, and Theodore Vail, then general manager, with this strategic vision, in which the importance of organization would supersede the patents.

Neil Wasserman's study of transmission technology offers the narrowest empirical focus among these books, but the broadest original conceptualization. Wasserman is interested in the management process of innovation. He defines this as a progression of steps through invention and then implementation. Invention entails a research project to develop, demonstrate, and patent a technology, conceived on some scientific base to achieve an identified need. After successful invention, implementation is necessary to establish the new idea's commercial value, design the production engineering, test it, and systematize the process (p. 10).

To test his hypothesis, Wasserman carefully chose a well-defined problem and a small, but important, invention. In the 1890s, long-distance transmission of telephonic signals was severely limited (to about thirty miles) by "attenuation," the reduction of signal strength. Since attenuation depended on the signal's frequency, certain frequencies would be absorbed more than others, causing distortion in voice communications. If the Bell System were to grow beyond local exchanges using high-quality long-distance cables, it needed some method of reducing attenuation. In 1899, a Bell engineer named George Campbell invented a solution—the loading coil. This device was a coil of copper wire wrapped around a donut-shaped iron core. When attached to a telephonic transmission line, the loading coil altered the electrical properties of the circuit by increasing induction proportionately more than resistance. This effect alleviated attenuation, making possible long-distance transmission of hundreds of miles.

But as Wasserman's analysis so effectively demonstrates, this sounds a lot easier than it was. The author treats the complex physics of electricity in considerable depth, and, more important, he has organized the intellectual and organizational progression for maximum clarity and insight. The first substantive chapter describes the nineteenth-century evolution in England of the relevant scientific principles, particularly the Heaviside Theory. This story, incidently, includes a fascinating vi-

gnette, reminiscent of the movie *Amadeus*, in which the brilliant but impoverished Oliver Heaviside clashes with the established but untalented William Preece. The next chapter explores the Bell System's problem, acquisition of scientific experts, and decision to undertake research. This is followed by the actual invention, its testing, conceptual elaboration, and finally (but belatedly), submission for a patent. The last substantive chapter, which is very important, details the difficult process by which the invention was put into commercial production and application. Here the author is at his best, showing the technical and organizational obstacles to implementation.

Wasserman concludes that, although later research on signal amplifiers has attracted more scholarly attention, "it was the earlier experience with loading that demonstrated the need to use advanced scientific theory in analyzing the problems of telephone transmission." Equally important, "the process of implementing loading engendered the creation of the research and development organization" at the Bell System (p. 6). For any reader interested in the Bell System's history, this story provides a valuable perspective on the relationship of technology to industry. For readers more broadly interested in the history of technology, or in the process of innovation, this case study equals any I have read.

If taken at face value, John Schacht's book on telephone unionism represents quite a different intellectual and philosophical approach to history. The author would no doubt bill himself as a labor historian or a social historian, not an institutionalist. He obviously admires anything that smacks of militancy, and indeed, seems critical of union leaders or rank-and-file at times when they seem cooperative with management or simply inactive. The author also distrusts AT&T's management and generally presumes the company's ill-will and exploitation toward its work force (notwithstanding the author's references to progressive benefits, a relatively passive response to unionism, and a strong reputation as a good employer).

Despite these surface effects, Schacht's book actually tells an extremely detailed and well-documented story of institutional evolution that reflects many of the same forces at work as we have seen in the company's history. The author's thesis is that the process of centralization that led to formation of the Communications Workers of America was a process of responding to environmental imperatives—especially the centralized nature of the Bell System and the federal government's enforcement of labor law. This, according to the author, is different from previous explanations of labor centralization offered by other scholars, including John Commons, Lloyd Ulman, Nelson Lichtenstein, and Robert Michels.

Schacht's book generally follows a chronological organization, starting with early efforts by the International Brotherhood of Electrical Workers (IBEW) to organize telephone workers. He describes the company unions that prevailed during the 1920s. Although these local organizations (about 180 of them) seemed responsive to workers' concerns, the author views their benefits and permanent employment cynically, as mere devices to block independent unionism. After 1935, the Wagner Act made independent unions much easier to organize—indeed, almost mandatory. At that time, the Bell System's unions became independent and affiliated in a loose-knit National Federation of Telephone Workers.

The heart of Schacht's story is the struggle between the more militant leaders who advocated centralization ("one company, one union") and the broader support for traditional autonomy. Between 1937 and 1947, the balance of power between these interests within the Federation gradually shifted in response to the centripetal forces of company and government. Management, according to Schacht, adjusted to the Depression by short-changing labor, not shareholders. By laying off thousands of long-time employees, AT&T kindled the first flames of militancy. Then, during the Second World War, government wage and price controls made telephone employment less desirable than industrial work. This, together with the War Labor Board's centralized administration, lent further support to the militant centrists within the Federation. The climax came in 1947, when most of the Federation's unions struck the Bell System, and lost, at the same time voting for a national union (the CWA).

Chapter 2 of this book, in which the author provides a thoughtful and graphic social history of telephone workers and telephone work in the decade prior to the Depression, is especially interesting and well done. Readers will get a real feel for conditions in central exchange offices, for the lifestyle of telephone workers, and for the social pressures between women and men, and between blue collar and white collar and office and outdoor employees.

Schacht's book has a single, important shortcoming: the author has scarcely studied the history of AT&T, allowing his preconceptions of managerial motive and practice to rule. Although his bibliography indicates that he used AT&T's archives, the fruits of that effort have been limited to Appendix C, where Schacht documents the centralized nature of AT&T labor policy. In a broader sense, the author's analysis of management's labor relations would be more accurate, although perhaps no less critical, if he took a lesson from the other authors and gave Chandler a careful reading. In fact, he might discover an intellectual framework rooted in sociology and industrial organization that could

substantially enrich his own perspective on the process of labor organization and growth.

All four of these research works deal with developments in the private sector of telecommunications, primarily before the Second World War. Apart from the antitrust settlement in 1913, the Wagner Act, and the War Labor Board, government's role does not loom large in these histories. But after 1920, regulation by state and federal government became an increasingly important factor shaping industry structure and market characteristics. In 1934, Congress created the Federal Communications Commission to foster "universal service," making public policy of Vail's company strategy. The half-century history of telecommunications regulation, and the shorter progress of deregulation, merit the next round of scholarly historical study that these works have just begun.

Louis Galambos

Theodore N. Vail and the Role of Innovation in the Modern Bell System

The record of long-term innovation at the American Telegraph and Telephone Company seems to defy conventional economic and social theories of the firm. The following essay, based on extensive research in the AT&T Archives, argues that CEO Theodore Vail made this possible by transforming the Bell System's orientation to innovation, its structure, and its culture. He also gave the System a cadre of leaders who sustained over the long term Vail's strategy of blending adaptive and formative innovations to promote network efficiency.

In 1907, Theodore Newton Vail became chief executive officer of the American Telephone & Telegraph Company and thus of the Bell System for which AT&T was the central holding company. As CEO he developed for the System a new and enduring corporate strategy that balanced several sometimes conflicting components. Vail sought, for instance, to achieve a high degree of control over Bell's political and economic environments. Indeed, by 1919 (when Vail retired as president), AT&T had managed to acquire a

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I am indebted to the AT&T Archives for assistance on this project; the help of Robert G. Lewis, Alan Gardner, Marcy Goldstein, Linda J. Straub, Jeffrey L. Sturchio, Bunny White, and Susan Brady was particularly valuable. At Johns Hopkins University, Betty Whildin, Susan Mabie, and the ever efficient Sharon Widomski made certain my drafts and redrafts were completed on time, and my chairmen, John Russell-Wood and Richard Goldthwaite, provided support throughout. I am also obligated to Richard S. Rosenbloom, George Smith, Alan Gardner, Robert G. Lewis, Naomi Lamoreaux, Richard Vietor, and many other scholars (this paper was discussed at seminars from Philadelphia to St. Louis, to Trinidad, and beyond) for their suggestions, and to the Assoziazione di Storia e Studi sull'impresa for enabling me to hold a seminar in Milan on an early draft of this article (which appeared in *Annali*). That draft was also discussed in Paris at a conference on modern management in historical perspective; I am grateful to professors Maurice Lévy-Leboyer and Patrick Fridenson for their assistance.

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new monopoly of U.S. long-distance service and a dominant position in the markets for telephone equipment and for local telephony. But Vail also wove into the strategy of this very large, regulated, corporate bureaucracy a long-term dedication to technological innovation, and therein rests the central problem of this essay. We do not usually expect to find a high level of innovation in monopolies, or in giant corporate bureaucracies, or in regulated firms.

To the contrary, the theory of the firm alerts us to anticipate that monopolies will be sluggish innovators. Their ability to appropriate most of the results of their research may encourage monopolies to spend more on R&D than firms in atomistic industries. But, lacking the pressure of competition, monopolists should be slow to explore and even slower to introduce new technologies; they should sit back on their haunches and enjoy the fruits of their market power.[1] This should particularly be true when the monopolist's position is shielded from entry by public policy, as was the case for the modern Bell System during much of its history.[2] One of the objectives of the recent deregulation movement has been to encourage innovation, and the same rationale has from the early years of the twentieth century been one of the justifications for antitrust policy.[3]

The social theory of bureaucracy similarly leads us to believe that regulated business bureaucracies will be slow to incur the risks of innovation. In this regard, they should behave like public bureaucracies, which are notorious for throwing up barriers to change. The bureaucratic structure of authority, with its elaborate hierarchy and stultifying procedures, should impede innovation. Moreover, because the managers of corporate bureaucracies lack price signals or the opportunity to reap large personal gains, they should resist the intrusion of new technologies with the same vigor

[1] Frederic M. Scherer, *Industrial Market Structure and Economic Performance* (Boston, Mass., 1980), 407–38. See also David C. Mowery, "Economic Theory and Government Technology Policy," *Policy Sciences* 16 (1983): 27–43; Richard R. Nelson, "The Simple Economics of Basic Scientific Research," *Journal of Political Economy* 67 (June 1959): 297–306; and Kenneth J. Arrow, "Economic Welfare and the Allocation of Resources for Invention," in National Bureau of Economic Research, *The Rate and Direction of Inventive Activity: Economic and Social Factors* (Princeton, N.J., 1962), 609–25.

[2] This element is stressed in Gerald W. Brock, *The Telecommunications Industry: The Dynamics of Market Structure* (Cambridge, Mass., 1981).

[3] See Stephen Breyer, *Regulation and Its Reform* (Cambridge, Mass., 1982), esp. 36-59.

Theodore N. Vail, 1883 • Vail is shown here during his first period of employment with Bell, when he was serving as general manager. He left the company in 1887, but returned in 1907 to lead the Bell System into the modern period. (Photograph reproduecd courtesy of AT&T Archives, New York, N.Y.)

that public bureaucrats display in protecting their turf from other government organizations. If the leaders of these private bureaucracies maximize on something, it should not be on technical progress.[4]

Under Vail, however, the modern Bell System became an innovative business—certainly one of the most technically advanced firms in the United States.[5] Although there is no way to

[4] Anthony Downs, *Inside Bureaucracy* (Boston, Mass., 1966); Martin Albro, *Bureaucracy* (New York, 1970); Michel Crozier, *The Bureaucratic Phenomenon* (Chicago, Ill., 1964).

[5] Throughout, I am dating the beginnings of the *modern* Bell System from 1907. During the period 1876–1906, the Bell interests performed in ways that were markedly different from the corporate behavior after Vail became president of the parent company. There were of course trends in company development that predate 1907, and I discuss some of these later; but in every case that relates to AT&T's technical development, there was a significant break in the trend after 1906.

For a different evaluation of innovation at Bell, see David C. Mowery, "Assessing the Predictions of the Effects of Divestiture on Bell Telephone Laboratories," draft

measure directly the degree to which a firm is innovative, there is considerable indirect evidence suggesting that the System's performance in this regard was extremely good over the long term. A narrative approach that enumerates and evaluates major technological breakthroughs produces a Bell System list that is very long and very impressive, including the electronic repeater, the transistor, and various fundamental developments in switching.[6] Another approach is to use data on productivity growth as a proxy for innovation. The only total factor productivity (TFP) study that permits an evaluation of a vertically integrated organization like the Bell System covered the period 1947–79 and indicated that Bell was still doing very well in this aspect of its business during the post–Second World War era. Between 1947 and 1979, Bell System productivity (TFP) increased by 3.8 percent per year, compared to 1.8 percent for the private domestic economy; in 1972–79, the figures were 4.9 and .7 percent, respectively. Output per employee increased at an annual rate (1951–79) of 6.8 percent in the Bell System and 2.3 percent in the private business sector.[7] This spotty evidence suggests to me that over the long term the modern System was able to remain innovative.

The tension between this evidence and our socio-economic theories also indicates to me that the changes Vail introduced in the management of the Bell System deserve careful attention. The problem is to explain how Vail shifted the System to a new course and why it continued on that path for such a long time. My subject is thus the managerial context that fostered innovation over the long term. Much of that innovation involved science and engineering, but my concern is less with the technology itself than with the successful management of technological change in a very large corporation.

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presented to the Business History Seminar, 22 Feb. 1988, Harvard University Graduate School of Business Administration. See also Kenneth Lipartito, "Innovation in the Telecommunications Industry, 1890–1990: An Overview and Case Study," Business History Seminar, 16 Dec. 1991.

[6] For abundant detail, see vols. 1 through 7, *A History of Engineering and Science in the Bell System* (Bell Telephone Laboratories, 1975–1985).

[7] "Bell System Productivity Study" (done in September 1980 by AT&T's economic analysis section; in AT&T Archives), covers the years 1947–79. The post–Second World War figures for the Bell System are comparable to those for the "communications and public utilities" group in the period 1909–48; see John W. Kendrick, *Productivity Trends in the United States* (Princeton, N.J., 1961), table 34, p. 137. See also Arthur D. Little, "The Relationship between Market Structure and the Innovation Process" (Jan. 1976), AT&T Archives.

Bell before 1907

When Vail stepped in as AT&T's CEO in 1907, the company had already experienced three decades of technological progress, a history in which Vail had played a substantial part. His hands-on, operating knowledge of the business would be a crucial factor in his reorientation of the System. He had served as Bell's first general manager (1878), had later become the president of AT&T (1885) when it was solely the System's long-distance subsidiary, and had briefly headed the important New York licensee, the Metropolitan Telephone and Telegraph Company. Metropolitan and Bell's other licensees enjoyed considerable autonomy in matters technical as well as economic; the System was complex and was loosely coordinated through stock ownership (see Fig. 1) and by dint of the interest all parties had in preserving their monopoly.

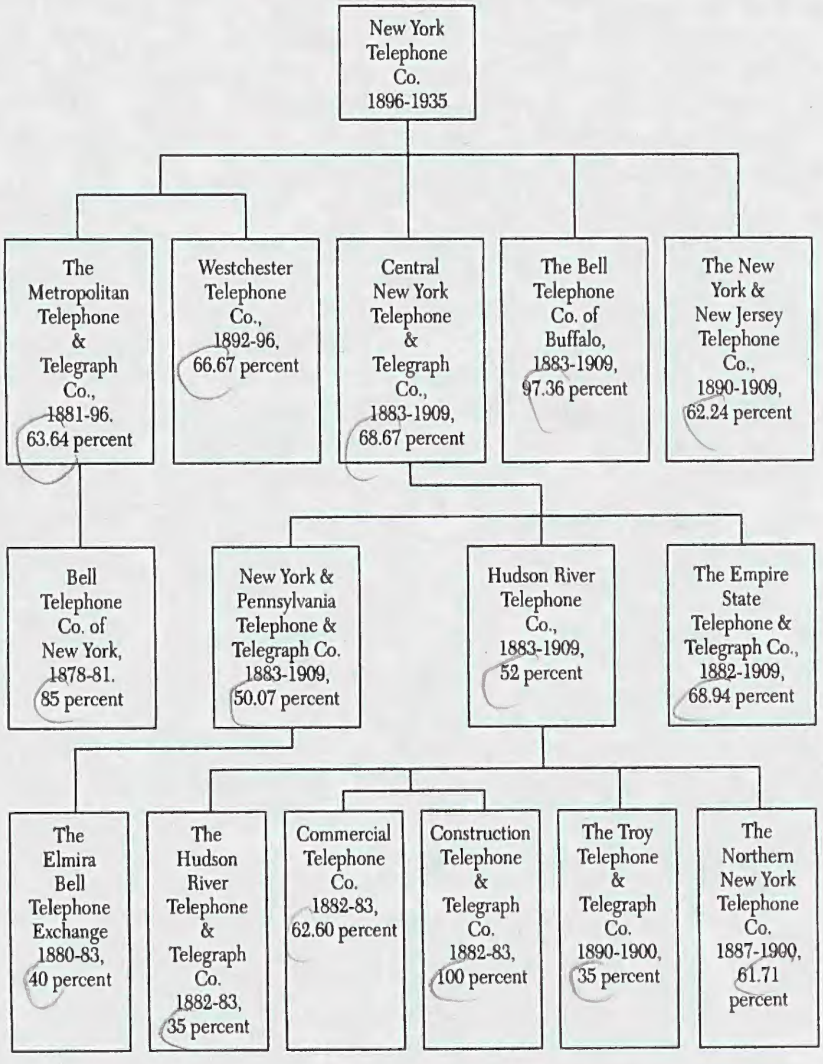
Through most of this period (that is, until 1894), the Bell interests enjoyed a relatively secure patent monopoly and, in the absence of competition, were able gradually to make progress in standardizing and improving the industry's technology. Because the System had evolved along highly decentralized lines, many of the local telephone exchanges had developed different kinds of equipment and wires, making it difficult for AT&T to link the exchanges for long-distance calls. As Vail saw the situation, however, Bell had to gird itself for competition by strengthening its long-distance service and thus maintaining an advantage over the new firms that were likely to enter the industry when the patents expired in the 1890s. Although he had no training in engineering or science, Vail vigorously promoted the technical standardization essential to the creation of what he hoped would eventually become an integrated national telecommunications network.[8]

From 1894 through 1906, this style of technical progress continued, but it was overshadowed by other more pressing considerations. During these years, a great wave of new firms entered the

[8] See Robert W. Garnet, *The Telephone Enterprise: The Evolution of the Bell System's Horizontal Structure, 1876–1909* (Baltimore, Md., 1985), 55–127. See also Neil H. Wasserman, *From Invention to Innovation: Long-Distance Telephone Transmission at the Turn of the Century* (Baltimore, Md., 1985), 33–125. On Vail's early career in telegraphy and the railway mail service, see John Brooks, *Telephone: The First Hundred Years* (New York, 1976), 67–160; Albert Bigelow Paine, *In One Man's Life: Being Chapters from the Personal & Business Career of Theodore N. Vail* (New York, 1921); and Robert Sobel, "Theodore N. Vail: The Subtle Serendipidist," in Robert Sobel and David Sicilia, *The Entrepreneurs: Explorations within the American Business Tradition* (New York, 1974), 194–246.

Figure 1

New York Telephone Co. and Predecessor Companies
(Investments in common stocks)



NOTE.—(1) Dates indicate period in which American Telephone & Telegraph Co. or its predecessors held common stock interests; (2) percentages indicate extent of ownership of common stock by American Telephone & Telegraph Co. or its predecessors at time of transfer of such stock to New York Telephone Co., or its predecessors.

Source: Federal Communications Commission, *Investigation of the Telephone Industry in the United States* (Washington, D.C., 1939), part 1, p. 23.

industry and fostered intense price competition and rapid expansion. Bell licensees had slightly more than 300,000 phones in use in 1895; ten years later the figure was 2,284,587. Vail missed the early years of competition, having left the Bell enterprise in 1887 to promote his fortune in a number of other ventures.[9] Out of the country much of the time, he lost contact with the industry. By the time he returned to AT&T, first as a director and then as the firm's president, telephony had experienced a dramatic change. About half of the telephones in service were supplied by independents—that is, non-Bell companies.

In an effort to meet this competition, AT&T (now the central holding company for the entire System; see Fig. 2) had overextended itself financially without, however, having succeeded either in blocking the progress of the independents or in maintaining a particularly high quality of service.[10] The struggle against the independents had further tarnished the Bell System's public reputation and weakened its political position (which was already precarious insofar as federal antitrust policy was concerned). In 1907, when AT&T was unable to sell its bonds, a J. P. Morgan–led banking group took control of the company and gave Vail the task of putting the Bell System back on its feet. Vail was thus under considerable pressure to develop a new firm strategy.

The Vail Strategy

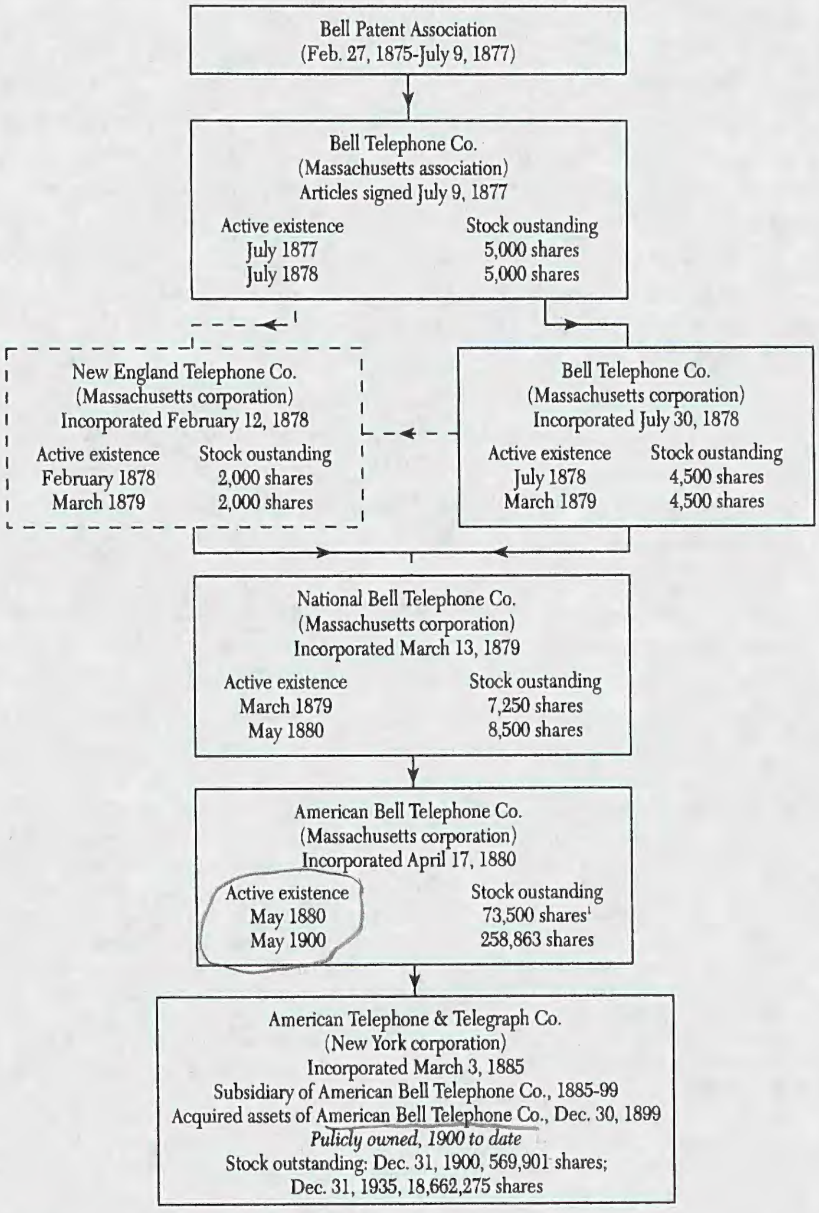
Two of the three major elements in that strategy are well documented and understood. Under Vail's forceful and intense leadership, AT&T gradually strengthened its position in its two primary markets: those for local and for long-distance telephone service. Along the way, the firm's manufacturing subsidiary became the dominant producer of telephone equipment in the United States. Initially, this drive for monopoly (or as Vail often put it, "control") came at the price of a further weakening of AT&T's political position, but Vail made peace with most of the public officials who

[9] Vail seems to have left Bell under unpleasant circumstances. He had apparently objected vigorously to what he thought was the short-sighted business strategy of the Boston investors who then controlled the System. Brooks, *Telephone*, 84–85.

[10] On the competitive era, see Federal Communications Commission, *Investigation of the Telephone Industry in the United States* (Washington, D.C., 1939), part 1, 129–46; and Brock, *The Telecommunications Industry*, 109–25. Vail's presidency marked the end of the dominance of the Boston investors in the Bell enterprise.

Figure 2

Historical Chart of the Parent Organizations of the Bell System



Legend: ——→ Transfer of assets.
– – → – Licensee company.

NOTE.—All stock of corporations is $100 par.

[1] Includes 14,000 shares of trustee stock held by National Bell Telephone Co.

Source: Federal Communications Commission, *Investigation of the Telephone Industry in the United States*, part 1, p. 2.

were concerned about developments in this important industry. Accepting state regulation of prices, profits, and service, Vail stymied the incipient movement for municipal ownership.[11] He compromised with federal authority, warding off an antitrust suit by accepting certain constraints imposed by the Department of Justice. This 1913 agreement—known as the Kingsbury Commitment—imposed limits on AT&T's acquisition of independents, required the Bell System to provide toll and long-distance service to any independents requesting interconnection, and forced the firm to divest itself of the Western Union Company, which it had bought in 1909.[12]

A third and equally important aspect of the Vail strategy involved a new emphasis on and qualitative changes in the Bell System's style of technological development. What emerged, gradually, was a more dynamic concept of how the firm would develop and introduce new technologies. This strategy and its implementation have not, I think, been fully understood from a managerial perspective. The focal points of Vail's new concept were thoroughgoing standardization, the internal development of science-based innovations, and the introduction of new technologies on a carefully phased, system-wide basis. As this strategy evolved, the expectational horizon of the enterprise pushed far into the future; eventually it came to be assumed within the Bell System that there would never be a time when technical innovation would no longer be needed or even when it would pay diminishing

[11] See, for example, Vail's first *Annual Report of the Directors of American Telephone & Telegraph Company to the Stockholders for the Year Ending December 31, 1907*, 18: "It is not believed that there is any serious objection to such [public] control, provided it is independent, intelligent, considerate, thorough and just, recognizing, as does the Interstate Commerce Commission in its report recently issued, that capital is entitled to its fair return, and good management or enterprise to its reward." See also T. N. Vail to P. Henry Woodward, 25 Feb. 1908, AT&T Archives: " . . . I am and always have been strongly in favor of public supervision, provided it is intelligent and reasonable." (Unless otherwise noted, all manuscript materials cited are in the AT&T Archives.) On the threat of municipal ownership, see Kenneth Lipartito, *The Bell System and Regional Business: The Telephone in the South, 1877–1920* (Baltimore, Md., 1989), 177-85.

[12] The agreement was set forth in a letter from AT&T vice-president N. C. Kingsbury (hence the name "Kingsbury Commitment") to the attorney general, 19 Dec. 1913; in J. C. McReynolds, attorney general, to N. C. Kingsbury, 19 Dec. 1913, the government accepted the terms "without litigation." See also Woodrow Wilson to James C. McReynolds, 19 Dec. 1913. All reprinted in *Annual Report . . . American Telephone & Telegraph Company . . . 1913*, 24–27.

returns.[13] One of the institutions crucial to this new strategy was the industrial laboratory, but the structural and ideological components of the new approach were much broader than the lab.[14] They involved all of the operating companies. The Western Electric Company—Bell's manufacturing subsidiary—played a central role in this transformation. Together these organizations and ideas gave the Bell System a momentum that would last long after Theodore Vail had retired as AT&T's president in 1919.[15]

Two Modes of Innovation

In spite of Vail's extensive experience in telephony, neither the new ideology nor the new institutions emerged full grown in 1907. They developed slowly, shaped by circumstances inside and outside AT&T—first by the fact that the Bell empire was tottering. The costs of rapid expansion had been too high, the returns too low to continue on that course over the long term. Vail began immediately to cut costs.[16] He abandoned the effort to occupy the entire field of telephony, promoting instead a selective policy of expansion and consolidation that would leave to Bell-connected independents the task of developing many of the country's less lucrative rural and semi-rural areas. These independents were for the first time given the opportunity to buy Bell telephones and

[13] In this regard the business strategy was similar to the ideology of the modern academic professions, all of which assume that progress in the development of their particular body of knowledge will continue forever. The spirit of this ideology was later captured by Vannevar Bush in his famous report, "Science: The Endless Frontier" (U.S. Office of Scientific Research and Development, 1945).

[14] The development of the industrial laboratories in the Bell System is described and analyzed in Leonard S. Reich's excellent book, *The Making of American Industrial Research: Science and Business at GE and Bell, 1876–1926* (New York, 1985).

[15] The idea of technological momentum is discussed in Thomas P. Hughes, *Networks of Power: Electrification in Western Society, 1880–1930* (Baltimore, Md., 1983).

[16] See, for instance, Reich, *Making of American Industrial Research*, 151–52. Reich emphasizes more than I do the role of J. P. Morgan in directing the reorientation of AT&T. Vail was clearly Morgan's choice to run AT&T, and during the fiscal crisis that accompanied the change in leadership, Vail stayed in close touch with Morgan. The records in AT&T's archives suggest, however, that Morgan's input was general rather than specific, transitory rather than lasting. In part, this outcome was no doubt a result of the decisive manner in which Vail took hold of the Bell System. On the Vail-Morgan ties, see the following letters from Theodore N. Vail: to John I. Waterbury, 18 July, 13 Aug. 1907; to J. P. Morgan, 11 Nov. 1907, with enclosure; to Charles Steele, 19 Nov. 1907; to Robert Winsor, 12 March 1908; to Messrs. J. S. Morgan & Co., 12 March 1908; to Charles W. Amory, 19 March 1909, with accompanying list. I could not find in the AT&T Archives the letter from Morgan to Vail that Reich cites on p. 151.

apparatus manufactured by Western Electric.[17] Meanwhile, Vail attempted to eliminate competition in the long-distance and the major urban markets.[18] The toll and long-distance business was the centerpiece of his business strategy. In order to control the industry, as Vail saw it, Bell had to do a better job of linking the various exchanges than any of its competitors; that goal would decisively shape the System's process of innovation.[19]

As he refinanced and brought the Bell System under control, Vail began to promulgate a new ideology that stressed technical achievement. To some extent these ideas were part of a service-oriented public relations campaign, but Vail's message was the same inside the System as it was outside. The message was repeated so frequently and forcefully that no one connected with the Bell System could have had any doubts about what the new president of AT&T wanted to accomplish. Bell facilities were beneath the standards that Vail wanted to uphold, and it was essential, he said in 1908, to accumulate "enough surplus to provide for and make possible any change of plant or equipment made desirable, if not necessary, by the evolution and development of the business."[20] He admonished the president of Western Electric: " . . . it is necessary that the Western Electric should have apparatus that in every respect is equal to that offered by the independent manufacturers." He thought that some of Western Electric's equipment was "in every way inferior. . . . If this is true, it must be remedied before any attempt to enter the field on your

[17] On this new policy, see the following letters from T. N. Vail: to E. M. Barton, 16 Aug. 1906; to E. C. Bradley, 23 Aug. 1907; and to N. C. Kingsbury, 25 Feb. 1908. To protect its all-important position in long distance, AT&T did not extend this policy to include loading coils and repeaters. T. N. Vail to H. B. Thayer, 24 June 1909. AT&T used sublicense agreements—contracts between licensees and independent firms in their territory—to achieve the same objective; see FCC, *Investigation of the Telephone Industry*, 153–55.

[18] See, for example, the following letters, all sent by T. N. Vail: to F. A. Pickernell, 8 July 1907; to H. M. Watson et al., 11 Oct. 1907; to L. G. Richardson, 17 March 1908; to George B. Fiske, 2 July 1908; to E. C. Bradley, 25 May and 1 June 1909. See also *Annual Report . . . American Telephone and Telegraph Company . . . 1909* [hereafter, *Annual Report*], 12. FCC, *Investigation of the Telephone Industry*, 137–41.

[19] See, for instance, T. N. Vail to Edward B. Field, 16 Nov. 1907. See also T. N. Vail, "Testimony in Western Union Telegraph Company et al., v. American Bell Telephone Company," Circuit Court of the United States, District of Massachusetts (copy in AT&T Archives; the testimony took place on 1 April 1908), 1549.

[20] *Annual Report . . . 1908*, 5–6.

part is made."[21] He emphasized the need for efficiency as well as economy in operations.[22]

Initially, Vail stressed the sort of standardization and interconnection that had been major themes of Bell development since the 1880s. It was this concept of technical change that was the underpinning for Vail's credo of "One System, One Policy, Universal Service." No collection of separate companies could give the public the service, he said, that Bell's "interdependent, intercommunicating, universal system could give."[23] Through Western Electric, properly managed, the System would be able to "control the development of the apparatus and the kind of apparatus that was to be made, standardize it in other words."[24] It was this type of technical standardization that had initially enabled Bell to develop the long-distance service that played a crucial role in Vail's corporate strategy.[25]

Important as it was to the early Bell System, standardization along these lines had an essentially static quality.[26] As a mode of innovation, it lacked the dynamic element that would come to characterize the Bell System in subsequent years. Instead of the development of new technologies, it envisioned the perfection through standardization of the existing array of equipment and lines in the various local exchanges. The same approach was applied to routine aspects of operations. This style of standardization would reduce risk, improve efficiency, and increase the System's income. But it was essentially an "adaptive" strategy of eliminating uncertainty in the process of producing equipment and providing services.[27]

This type of systematization, which was extremely popular in turn-of-the-century U.S. business, was soon to be supplemented at AT&T by a strategy that would also emphasize the kind of "for-

[21] T. N. Vail to E. M. Barton, 16 Aug. 1907.

[22] *Annual Report . . . 1907*, 8.

[23] Ibid., *1909*, 18.

[24] Vail, "Testimony in Western Union," 1556.

[25] See T. N. Vail to Edward B. Field, 26 Nov. 1907; and Garnet, *The Telephone Enterprise*, 66–69, 136–37.

[26] See, for instance, the remarks in *Annual Report . . . 1903*, 6–7; and *Annual Report . . . 1905*, 7–9.

[27] The difference between adaptive and innovative strategies is developed in William Lazonick, *Business Organization and the Myth of the Market Economy* (New York, 1991), esp. 213–27. I have used several of Lazonick's highly original ideas, but I have twisted them to fit my own analysis of the Bell scenario. My apologies to their author.

mative" innovations that introduce new technologies, shift production functions decisively, and thus normally increase risk. Vail's concept of formative innovations would, however, emerge very slowly. In 1908, he described development in the telephone business as "continuous." He said that "the whole business suggests changes and stimulates inventions. . . . " The Bell System's engineering department "takes all new ideas, suggestions and inventions, and studies, develops, and passes upon them."[28] He was then still assuming that the innovations would come from outside the System, but shortly he would look to internal generation of new products and processes. A year later, he was extolling Bell's bureau of "research and information," which consisted of "technical, electrical and mechanical operating experts," who knew "all that had gone before and all that was being done here and elsewhere."[29] By 1910 he could point to "extensive laboratories and experimental departments with technical staffs competent to keep abreast of modern progress. . . . "[30] The Bell System was now generating its own fundamental innovations and was capable, Vail said two years later, "of continuing to grow indefinitely not only in size but in constantly increasing efficiency and usefulness."[31]

AT&T's scientific and engineering success (by 1914–15) in establishing transcontinental service capped this development in Vail's business strategy.[32] The company's work on the electronic repeater, a crucial element in transcontinental service, was clearly formative, not adaptive, innovation. Now Vail conceived of the System as "an ever-living organism." Its development involved "unceasing effort, continually improving and upbuilding . . . ," never "standing still." Formative innovations were produced by the System's "comprehensive and effective engineering, scientific development and manufacturing organization. . . . " Bell's scien-

[28] *Annual Report . . . 1908*, 16–18.

[29] Ibid., *1909*, 19.

[30] Ibid., *1910*, 27.

[31] Ibid., *1912*, 22. See also T. N. Vail to E. C. Bradley, 6 Aug. 1912; and T. N. Vail to Mr. Scott, 24 July 1912. In the latter, Vail pointed out the value of AT&T's "large experimental and developing departments. . . . " Comparing "the state of the art . . . even five years ago, . . . with the present, the gain in every respect—efficiency and economy of operation and possible distance of transmission—has been enormous, all the result of the central organization and the engineering and experimental departments."

[32] Both Reich, *Making of American Industrial Research*, 159–64, and Lillian Hoddeson, "The Emergence of Basic Research in the Bell Telephone System, 1875–1915," *Technology and Culture* 21 (1981): 529–37, stress the importance of this achievement and the work done to accomplish it.

tific research, he later noted, "has grown into one of the largest laboratories of the application of science to industrial development in the world. . . . "[33]

In Vail's strategy these two modes of innovation had to be carefully coordinated, and the relationship between adaptive and formative efforts became a critical feature of the revamped Bell System. With the national network potentially complete, Vail laid the foundation for what would become the network mystique, the ideology of systems engineering. As Vail saw it, there should be no false steps in the process of technical change. "The plant and methods of each company must be co-ordinated with those of all of the other companies, because each is but a part of the unified structure. . . . " As he explained: "A good idea may spring up in the mind of man anywhere, but as applied to such a complex entity as the Bell System, the countless parts of which cover the whole United States, no individual unaided can bring the idea to a successful outcome." What was needed were the System's substantial scientific and engineering resources. The innovations they produced were essential to the System's improvement, but they had always to be "co-ordinated and carried on in connection with the practical operation over . . . [the entire] system. . . . "[34] By this time, the Vail concept of innovation—a blend of science-based formative research with adaptive development work under systems engineering constraints—was fully articulated.

Restructuring the System

To be sustained over the long term, however, this corporate strategy had to be embodied in the firm's structure. Vail's initial step as AT&T president appears at first glance to have been in the wrong direction. In the course of consolidating the System's R&D resources, Vail cut back sharply on the staff.[35] But by centralizing

[33] *Annual Report . . . 1914*, 18–20; *1915*, 22–25. See also T. N. Vail, "Some Observations on Modern Tendencies," in *Views on Public Questions: A Collection of Papers and Addresses of Theodore Newton Vail, 1907–1917* (privately printed, 1917), esp. 251–54. Theodore N. Vail to John A. Moon, 30 Dec. 1918 ("Wire System: Discussion of Electrical Intelligence"), AT&T Archives.

[34] *Annual Report . . . 1914*, 18–20; *1915*, 22–25. See also Theodore N. Vail, *Policy of Bell System* (New York, June 1919).

[35] Reich, *Making of American Industrial Research*, 151, emphasizes this cutback. On the effort to economize, see T. N. Vail to E. J. Hall [and other Bell company presidents], 1 May 1907.

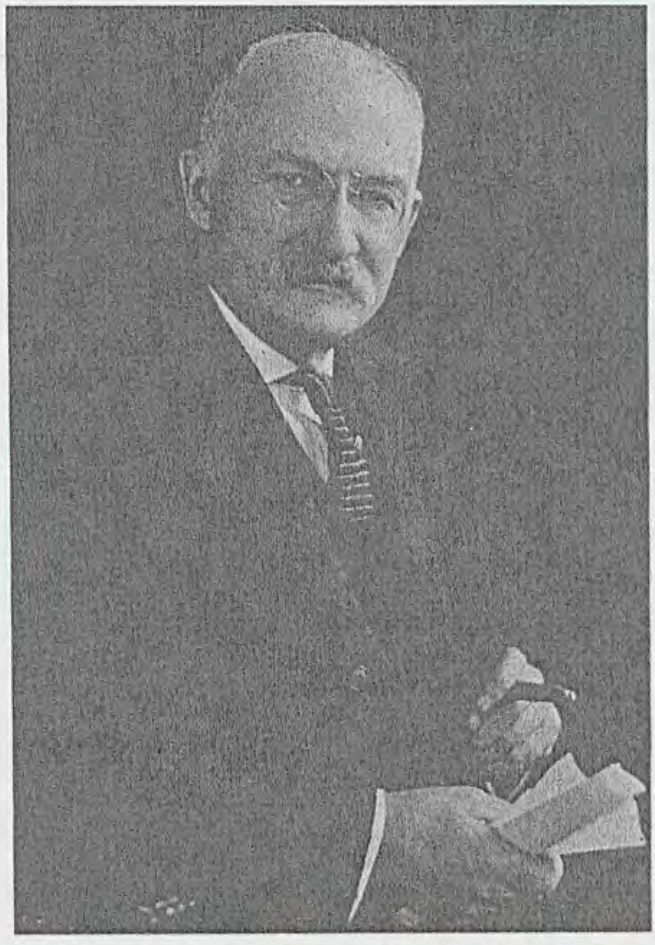
the research and development operations, by bringing them closer to manufacturing, and by placing them under new, vigorous leadership, Vail laid the foundation for the subsequent expansion and improvement of these operations.[36] Before that transpired, however, he turned his attention to the fundamental organization of the System.

Vail consolidated and reorganized AT&T, the long-distance service, Western Electric, and the several operating agencies and companies. The hardest to change were the operating companies, most of which were long accustomed to a high degree of autonomy. In 1906 (before Vail became CEO), AT&T's chief engineer Hammond V. Hayes had sent the company's president a depressing report on the efforts to upgrade and coordinate the technology at the operating company level: "The general relations of the [AT&T] Engineering Department to the telephone interests at large is unsatisfactory. . . . " As he explained, "our relations with the operating companies are dependent upon personal good will and the influence and prestige that comes from men well equipped and doing good work. . . . " But still, "many of the [operating firms'] engineers disregard recommendations and specifications which we consider proper and substitute others on the same subject many of which are improper and do not operate to the best interests of their own company nor of the business at large." Hayes had, nevertheless, been hesitant to wrest authority from the local engineers.[37] Vail was not. After taking the helm and putting the System's finances in order, he began to increase AT&T's financial stake in the operating companies, pushed their managers to reorganize along functional lines, and set his number one operating officer, the quiet but tenacious Henry B. Thayer, to work on this problem.

Thayer was president of Western Electric and, after 1909, a vice-president of AT&T. Under his direction, members of AT&T's Engineering Department began to work closely with their counterparts in the operating companies and to develop a reporting system that facilitated comparative analyses of company performance. Thayer and AT&T's engineers used these reports to drive

[36] Reich, *Making of American Industrial Research*, 151–53; also J. J. Carty to E. J. Hall, 17 July 1907.

[37] Hammond V. Hayes to F. P. Fish, 31 Dec. 1906.



Henry B. Thayer • Thayer came to Western Electric in 1881 and became president of the company in 1908; in this and other capacities until 1919, when he left WECo to succeed Vail as president of AT&T, he was instrumental in helping Vail establish his vision of the "Bell System." (Photograph reproduced courtesy of the AT&T Archives.)

the process of standardizing equipment and practices.[38] What emerged from this process was a more centralized structure orga-

[38] See, for instance, H. B. Thayer, Memorandum for T. N. Vail, 27 May 1909; J. J. Carty, Memorandum for Mr. Thayer. 9 Oct. 1909; H. B. Thayer to George E. McFarland, 11 Nov. 1913; H. B. Thayer to W. T. Gentry, 1 June 1914. Some degree of centralization also took place in legal and rate-making matters; see T. N. Vail to H. M. Watson [and other Bell company presidents], 30 April 1908. By 1916, after a year's study in the field, AT&T's comptroller reported: "We have a strong centralized administration of engineering. . . . " Charles G. DuBois to U. N. Bethell, 26 May 1916.

nized along functional lines. The highest degree of centralization was in the area of technology. Political and financial affairs were still relatively decentralized in the modern Bell System. Clearly this new arrangement made for better coordination of policy: as Vail said, "we are harmonizing our different companies. . . . "[39]

The focus during this first stage of reorganization was on adaptive change but, directly and indirectly, the new structure would also encourage formative innovations.[40] In the course of reorganizing the horizontal component—that is, the operating level—of the Bell System, Vail revised and standardized the license contracts so that eventually all of the Bell operating companies paid 4.5 percent of their gross revenue to AT&T for the central administration of the System, including its research and development activities. As Vail explained:

> In the reconstruction of switchboards and Central Office apparatus, the value of this connection with the American Telephone and Telegraph Company is very great. . . . In the past few years the interior apparatus and the interior operation of the Central Office has radically changed, and it is probable that the changes in the next few years will be still greater. All of these changes have been necessary to increase the efficiency, the distance and the certainty of the exchange service, and particularly the toll service which has increased in a marked degree.[41]

Once this fiscal relationship was built into the license contracts and accepted by the state regulatory commissions—of which there were forty by 1913—the funding for research as well as for development was on a relatively secure basis.[42]

This was the solid foundation on which Vail gradually built up the new institutions that would ensure over the long term that the System could sustain a high level of innovation and would always

[39] T. N. Vail to William A. Childs, 25 Feb. 1908. See also T. N. Vail to B. E. Sunny, 6 April 1909 The "harmonizing" in operations was done less aggressively than in matters involving technology, but gradually System-wide standards for operations were devised and implemented.

[40] The Bell System's three-column structure is discussed in Garnet, *The Telephone Enterprise*, 135–46. The functional organization replaced a territorial structure. See also George David Smith, *The Anatomy of a Business Strategy: Bell, Western Electric, and the Origins of the American Telephone Industry* (Baltimore, Md., 1985), 135–38; and FCC, *Investigation of the Telephone Industry*, 185–204.

[41] T. N. Vail to E. C. Bradley, 6 Aug. 1912; see also T. N. Vail to Mr. Scott, 24 July 1912.

[42] The protracted controversy over this aspect of the license contract and its resolution by 1918 are described in FCC, *Investigation of the Telephone Industry*, 149–51.

have on board advocates for investments in new technology.[43] In addition to Thayer, the new technical elite in the Bell System included John J. Carty, who replaced Hammond V. Hayes in 1907 as head of the Engineering Department. Hayes had for some time maintained that AT&T should concentrate on "the practical development of instruments and apparatus. I think the theoretical work can be accomplished quite well and more economically by collaboration with the students of the [Massachusetts] Institute of Technology and probably Harvard College."[44] Hayes explained in 1906 that "no one is employed who, as an inventor, is capable of originating new apparatus of novel design. In consequence of this it will be necessary in many cases to depend upon the acquisition of inventions of outside men. . . . " It would be expensive and "probably unproductive," Hayes said, to try to employ men with "unusual scientific attainments. . . . "[45] When Hayes wrote this timid report, Carty, Frank B. Jewett, a Ph.D. physicist, and several other scientists and science managers who would lead the System's R&D into the new era were already working for Bell.[46] Vail brought this sort of leadership to the top, and as soon as he and Thayer had made substantial progress in reorganizing the System, they gave Carty the financial support he required to ensure that the business would have all of the scientific and engineering personnel needed to conduct internally its theoretical research as well as its practical efforts in development.[47]

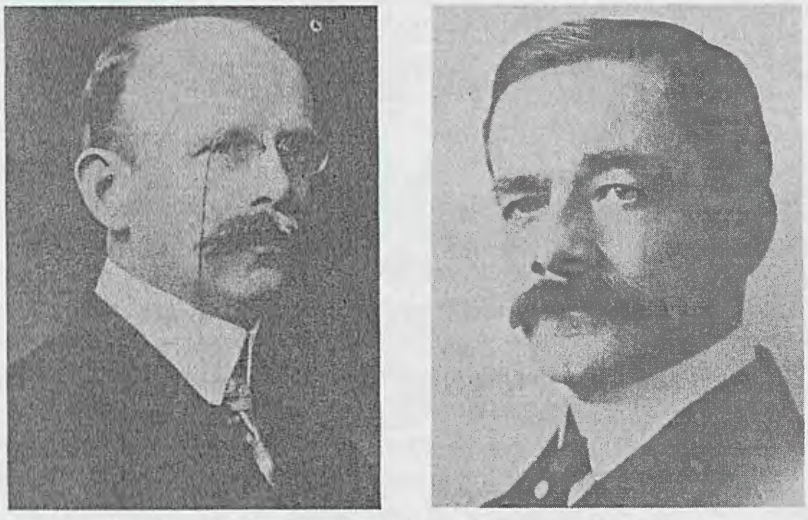
[43] Several recent studies of corporate R&D have stressed this political dimension—that is, the need for effective R&D spokespeople within the firm—of the process of innovation. See, for instance, David A. Hounshell and John K. Smith, *Science and Corporate Strategy: Du Pont R&D, 1902–1980* (New York, 1988); Margaret B. W. Graham, *RCA and the VideoDisc: The Business of Research* (New York, 1986); Reich, *Making of American Industrial Research*.

[44] As quoted in Wasserman, *From Invention to Innovation*, 19. For Hayes's career, see Roger B. Hill and Thomas Shaw, "Hammond V. Hayes: 1860–1947," *Bell Telephone Magazine*, Autumn 1947, 151–73. On AT&T's relationship with MIT, see also David F. Noble, *America by Design: Science, Technology and the Rise of Corporate Capitalism* (New York, 1977).

[45] Hammond V. Hayes to F. P. Fish, 31 Dec. 1906.

[46] "Organization. Engineering Department. American Telephone and Telegraph Company, January, 1905."

[47] AT&T continued to support some university theoretical work; see T. N. Vail to Richard C. Maclavrin, 18 Feb. 1913; Harold Pender to J. J. Carty, 18 June 1913; Charles G. DuBois to J. J. Carty, 28 July 1913; and Nicholas Murray Butler to T. N. Vail, 27 Feb. 1914. But Carty decisively opted for internalizing the R&D function; see J. J. Carty to T. N. Vail, 27 July 1915, enclosing "Industrial Research Laboratories in Universities." Thayer ultimately terminated the MIT work in 1924; H. B. Thayer to Everett Morss, 11 Dec. 1924.



Hammond V. Hayes and J. J. Carty • Hayes (left) directed the Mechanical Department (later the Engineering Department) at the American Bell Company from 1885 until he was replaced by Carty in 1907. In contrast to Hayes, who had a rather timid view of the possibilities, Carty shared Vail's belief in the ability of Bell's own scientists to produce both adaptive and formative innovation. (Photographs reproduced courtesy of the AT&T Archives.)

R&D was reorganized as well as redefined, along lines that stressed functional subdivision and thorough coordination within the System's vertical structure. One wing of the new operation was at AT&T in New York, where Carty ran the Engineering Department under Thayer's careful control. Some of the department's work was of the sort that I have identified as "adaptive": it promoted standardization and searched for "the most economical and efficient methods" of both construction and maintenance; it devised "plans for the more economical use of toll lines, local lines and operating economies. . . . "[48] Other work of the refurbished Engineering Department—especially after 1909 and 1910—involved a search for formative innovations: for instance, the development of new means of improving long-distance transmission and explorations into wireless telephony.[49] The AT&T department's chief role in this work might best be termed "R&D Planning": it decided exactly what the System needed and what

[48] J. J. Carty, Memorandum for H. B. Thayer, 8 April 1909; H. B. Thayer, Memorandum for T. N. Vail, 27 May 1909.

[49] J. J. Carty, Memorandum for H. B. Thayer, 8 April 1909.

the specifications of the innovation should be; then it turned over the tasks of both research and development to the Western Electric Company (WECo). In effect this setup placed R&D planning and R&D operations under two specialized organizations, much as Du Pont and other firms would later separate strategic decision making from operations.[50]

The manner in which R&D was organized and positioned within the System had a significant effect on the balance between adaptive and formative innovation. Western Electric's separate Engineering Department was the major center for the operational aspects of research and development work in the entire Bell System. Organizationally this placed R&D close to manufacturing and would normally have been expected to favor the short-term developmental side—that is, the adaptive mode of innovation. In this case, however, geography triumphed over organization, because both the WECo and the AT&T engineering departments were in New York, and their work was closely aligned. All orders from the Bell System for supplies or equipment were now funneled through AT&T. From WECo's perspective, that made AT&T its largest "customer" and justified locating the Engineering Department in New York.[51] In effect, this arrangement ensured that the adaptive work would be coordinated with, but would not overwhelm, the nascent efforts at formative innovations.

This new structure created a fault line, however, between R&D and manufacturing, a problem that also arose in other high-technology firms. In the Bell System the problem became serious enough by 1915 to prompt Western Electric's management to organize its first "Manufacturing and Engineering Conference"—held for obvious and symbolic reasons in Chicago near the firm's Hawthorne manufacturing plant. Although the conference and the changes in procedure that it prompted probably eased tensions between the engineering and the manufacturing operations, they appear not to have altered the balance between adaptive and formative efforts in WECo's R&D.[52]

[50] See Alfred D. Chandler, Jr., *Strategy and Structure: Chapters in the History of the Industrial Enterprise* (Cambridge, Mass., 1962), 52–113.

[51] See Western Electric Company, *Manufacturing and Engineering Conference*, Chicago, Illinois, 24–28 May 1915 (the pages in this report are not numbered consecutively, so I have not used page numbers). The R&D organization in WECo was about four times the size of AT&T's Engineering Department.

[52] Ibid. Also see Hounshell and Smith, *Science and Corporate Strategy*, for numerous examples of this type of organizational tension.

During these years, Western Electric's emphasis on basic research and formative innovations steadily increased. In 1911, the firm organized a special research branch within the Engineering Department, and the following year Frank Jewett moved over from AT&T to direct some of the more significant research projects. By 1915, when Thayer returned to the presidency of WECo, there were forty to forty-five people, including seven Ph.D. scientists, working in the Research Branch.[53] By that time, as well, the two engineering departments had produced the sort of formative innovation that had become one of their primary goals. The work done on the audion, the triode amplifier, and the electronic repeater made transcontinental long-distance service possible for the first time (1915). This technical accomplishment was perfectly suited to the Vail business strategy. It broke down the last technological barrier to "universal service" and provided the Bell System with a formidable advantage over any firm attempting to enter the business.[54]

The WECo style of innovation in the Vail era was tightly focused and paced with System-wide considerations in mind. The balance was never allowed to tip very far toward either adaptive or formative innovation. The transmission problems that were of central concern to the Vail business strategy received top priority, and resources that could have been used in other ways (for instance, to introduce automatic switching as soon as possible or to satisfy customer demand by developing a successful hand set, the so-called French phone) were concentrated on improving long-distance service.[55] WECo's adaptive programs were also attuned to Vail's strategy. Hence WECo standardization routinely called for more expensive apparatus than an independent manufacturer might have produced, on the grounds that it would achieve operational economies for the integrated network. The process of innovation was therefore more focused, probably slower, and no doubt

[53] Hoddeson, "Emergence of Basic Research," 534.

[54] See H. S. Sheppard, Memorandum for Mr. Gifford (with enclosure from J. J. Carty), 1 June 1921; Hoddeson, "Emergence of Basic Research," 515–16, 531–40; Reich, *Making of American Industrial Research*, 160–76. The competitive aspects of Bell's technological innovations are laid out especially in J. J. Carty, Memorandum for H. B. Thayer, 8 April 1909.

[55] On automatic switching, see Kenneth Lipartito's excellent analysis in "Innovation in the Telecommunications Industry, 1890–1990," esp. 19–52. On the French phone, see H. B. Thayer to J. Epps Brown, 23 Feb. 1915. A somewhat similar situation arose in regard to certain private branch exchanges; see H. B. Thayer to P. L. Spalding, 21 April 1913, and H. B. Thayer to W. T. Gentry, 21 Oct. 1914.

Frank B. Jewett • Jewett came to Bell after receiving his Ph.D. in physics from the University of Chicago. In 1925 he became the first president of Bell Telephone Laboratories. (Photograph reproduced courtesy of the AT&T Archives.)

steadier than it would have been under more competitive conditions.[56] As Frank Jewett explained to the 1915 conference of engineers and manufacturers, the utility of their elaborate and time-consuming trial installations of new equipment had frequently been questioned. But, he said, these trials had always uncovered "some serious trouble . . . ":

> With multipliers such as those in The Bell System and with reactions throughout the telephone plant which it is impossible to foresee, the results of mistakes and errors are too serious to warrant taking chances with. It requires little imagination to picture the chaos which would obtain if we introduced a new multiple jack which was to develop serious trouble at the end of a year or fifteen months. By the time the defect could come to light in ordinary service and a change be made, there would be literally hundreds of

[56] See also Reich, *Making of American Industrial Research*, 246–47. These aspects of corporate innovation may well explain some of the anomalies in the empirical data discussed in Scherer, *Industrial Market Structure and Economic Performance*, 433–38.

> thousands of defective units scattered broadcast through the system like so many foci of disease.[57]

The WECo Engineering Department was determined to keep the network as free as possible of technical "disease," and it paced both formative and adaptive changes accordingly. Vail's newly restructured Bell System successfully managed the inherent tension between these two modes of innovation.

Continuity, Cadres, and Communication

Effective as this new structure was, the modern Bell strategy of innovation might not have lasted as long as it did had Vail not given serious thought to the need for continuity of personnel, from the top to the bottom of the business, and for improved communications within the System. As we have already seen, Vail quickly promoted to positions of authority a new cadre of technically oriented officers. Thayer was Vail's lieutenant, whether he was a vice-president at AT&T or the president of the Western Electric Company. He was the archetypal operations man, with his finger on the pulse of the business, including the process of innovation. Directly under Thayer was J. J. Carty, who became the chief spokesman at AT&T for systematic technological development and basic research. It was Carty who worked up the regular reports on the dollars saved through effective R&D; these estimates found their way to the top of the corporation and then into Vail's annual reports to the stockholders.[58] Others on the Vail-Thayer fast track included Frank B. Jewett, who became WECo's chief engineer in 1916, and Walter S. Gifford, who moved in 1908 from Western Electric to AT&T, where he served as chief statistician from 1911 to 1916. Since Vail's tenure as president lasted from 1907 to 1919, he had time to nurture this new managerial elite, all of whom were well schooled in the modern Bell strategy of innovation.

As Vail prepared to retire to the chairmanship in 1919, he

[57] F. B. Jewett, "Development of New Apparatus for Manufacture," in Western Electric Company, *Manufacturing and Engineering Conference*, 1915. See also the remarks of E. B. Craft on cutting costs.

[58] See, for example, *Annual Report . . . 1911*, 24, and *1912*, 25. See also Theodore N. Vail to John A. Moon, 30 Dec. 1918 ("Wire System"), 10. Carty was an advocate of basic research, but he meant by that expression research into the basic scientific concepts needed to solve specific technological problems. The research and development efforts were all tightly focused.

carefully positioned this cadre of managers to take over the company and to carry forward the work he had begun. The two CEOs prior to Vail had been lawyers, familiar with Bell's legal problems but not with its technical operations.[59] Vail wanted a telephone man, an internal appointment, and he chose the experienced Henry B. Thayer. As Vail explained, "In the manufacturing he has had more intimate connections with the actual operations of the system than any one man connected with the system. He has had a more intimate acquaintance with the personnel of the system than any other one man, and has had a more intimate acquaintance with the problems to be solved than almost any other man."[60] Vail—who might have been describing himself as of 1907—would thus ensure that the reorganized Bell System would stay on course.[61] To support Thayer, he appointed J. J. Carty a vice-president of development and research, a new position (heading a now separate department) that accurately reflected the new corporate strategy. Jewett stayed in his crucial role at WECo's engineering operation, while Gifford became vice-president in charge of accounts and finance.

The quest for continuity actually reached from the boardroom to the shop floor and the switchboard. The newly reorganized operating companies became training grounds for the technically oriented officers who would manage the System in the future. These companies now had "uniform sets of officers," and Vail closely watched their performance. As he observed in 1911, "With such a body of men, educated in technicalities and theories, which by practical experience, they have subordinated to usefulness with a trained capacity for taking responsibility—steadily moving upwards—there will always be a body of fit men to choose from. . . . "[62] Vail and Thayer included blue-collar as well as white-collar workers in the new dispensation. By cutting turnover

[59] Since I am not counting Alexander Cochran's temporary appointment (1900–1901), the reference is to John E. Hudson (1889–1900) and Frederick P. Fish (1901–7).

[60] T. N. Vail to Major Higginson, 18 June 1919.

[61] Jameson W. Doig and Erwin C. Hargrove, *Leadership and Innovation: A Biographical Perspective on Entrepreneurs in Government* (Baltimore, Md., 1987), stresses similar aspects of successful entrepreneurship in public life; see esp. 8, and John Milton Cooper, Jr.'s interesting essay on "Gifford Pinchot Creates a Forest Service," 63–95.

[62] T. N. Vail's letters: to William A. Childs, 25 Feb. 1908; to H. J. Pettengill, 31 Jan. 1908; to L. G. Richardson, 17 March 1908; to George E. McFarland, 16 March 1909; to B. E. Sunny, 3 June 1909; to H. M. Watson, 31 Aug. 1909; to Major Higginson, 18 June 1919; *Annual Report . . . 1911*, 28–29.

and ensuring that employees were loyal to the System, they could be more certain that the new ideology of efficiency, high-quality service, and technological innovation would persist. In this spirit, AT&T instituted pensions (1913), a disability plan (1913), and a stock purchase program (1914) for Bell System employees.[63] Western Electric provided hospital services and athletic facilities and set up a training division for new employees.[64] Managers who could not reduce turnover were given pointed instructions from AT&T headquarters to improve their performance.[65]

Vail also intensified communications throughout the System and, in so doing, helped to transform his ideology into a lasting corporate culture. He believed in learning by repetition. All of the troops heard his message—again and again. He began to hold meetings of the chief managers throughout the country.[66] Thayer later transformed these gatherings into regular and more formal conferences of the top executives of AT&T, Western Electric, and the operating companies.[67] Under Vail, the several companies in the System began to issue more numerous and lengthier bulletins on technical and legal affairs; in 1912, Western Electric began to publish a monthly newsletter for its employees. The woof of the *Western Electric News* consisted of personal items, pictures, reports on athletic events, poems, and cartoons, but the warp lay in the themes of efficiency and technological innovation. Articles on "Engineering Development Work," "Untechnical Talks on Technical Topics," and "Eight Messages Over One Wire" were woven together with pieces on "Lon Dillon" (one of WECo's oldest foremen), "The Fine Art of Saving," and the "Women's Page." Even these lighter items embodied a moral, of course, and a typical article on the "Women's Page" reported that "five hundred

[63] *Annual Report . . . 1912*, 17–19; as Vail explained, "Perfect service is only to be found when fidelity and loyalty are reciprocal in employer and employee" (19). *Annual Report . . . 1914*, 29–32.

[64] *Western Electric News* 8 (July 1919): 10–15; (Nov. 1919): 29. At this time, hardly any Bell System employees were unionized, and one of the goals of these programs may have been to prevent the development of independent unions.

[65] See, for instance, H. B. Thayer's thirteen-page letter to George McFarland, 24 Dec. 1913.

[66] T. N. Vail to John Waterbury, 13 Aug. 1907; Connie Jean Conway, "Theodore Vail's Public Relations Philosophy," *Bell Telephone Magazine*, Winter 1958–59, 44.

[67] "Notes of Certain Talks at Presidents' Conference Held in New York," 8–10 Dec. 1919; H. B. Thayer to M. B. Jones, 3 June 1920; "Yama Farms Conference," 4–9 June 1921.

girls were in this department and one girl said she soldered on 3,600 tips a day. You can judge by this that they have things down pat in this shop."[68]

Did these efforts at socialization matter at all? Did they have any impact on either managers or shop-floor workers? Apparently they did. In combination with the procedural changes in employee relations, they seem to have produced a formidable culture throughout the Bell System. Efficiency and technological innovation became central elements in the network mystique. As one manager noted in 1915, he worked in "an organization whose business it is to apply the knowledge of science to supplying facilities for the communicating of intelligence in the service of the public. . . . We all of us take pride in the part which this company has taken in the growth of the art of telephony."[69] Nor were pride and a positive attitude toward technical progress manifested only by managers. Blue-collar adaptive innovations were important to WECo; they were described in *Western Electric News* and lauded. "The suggestions come from all the employees through the works. . . . By prompt attention to the suggestions that have been received, by taking pains to let the individuals know that some attention is given to their ideas and that some use is made of them, we have doubled the number of suggestions that we are receiving. . . . "[70] From the top down and from the bottom up, the culture of innovation pervaded the modern Bell System.

When Thayer replaced Vail as president of AT&T, the new CEO held the System on the same course that his mentor had charted. If anything, Thayer was even more of a hands-on executive, and he stayed especially close to J. J. Carty and the process of technological innovation.[71] Under Thayer, the Bell System launched the *Technical Reprint Series* and in 1922 started two new publications, the *Bell Telephone Quarterly* and the *Bell System Technical Journal.* The development of radio during these years

[68] *Western Electric News* 1 (March 1912): 9–10; 2 (Aug. 1913): 26–27 [the subject was "The Telephone Induction Coil and How It Is Used"]; 4 (April 1915): 1–6; ibid., 28; 5 (Nov. 1916): 5; 2 (April 1913): 25.

[69] These remarks were by R. L. Jones at Western Electric Company, *Manufacturing and Engineering Conference*, 1915.

[70] P. J. Gilman in ibid.

[71] See, for example, J. J. Carty to H. B. Thayer, Oct. 1920; L. F. Morehouse to G. A. Campbell, 7 Dec. 1922; J. J. Carty to H. B. Thayer, 21 Nov. 1924.

posed threats and promised major benefits to the Bell System. Thayer made certain that AT&T stayed on the front edge of this technology.[72]

In December of 1924, Thayer pushed functional specialization forward one additional step by organizing the Bell Telephone Laboratories as a separate corporate entity under president Frank B. Jewett.[73] Bell Labs was the organizational embodiment of the ongoing quest for formative innovations. The main locus of adaptive change continued to be Western Electric, but the balance between the two modes of innovation was preserved: Western Electric—along with AT&T—owned Bell Labs and provided the new organization with most of its top research and engineering managers (as well as its building in New York).

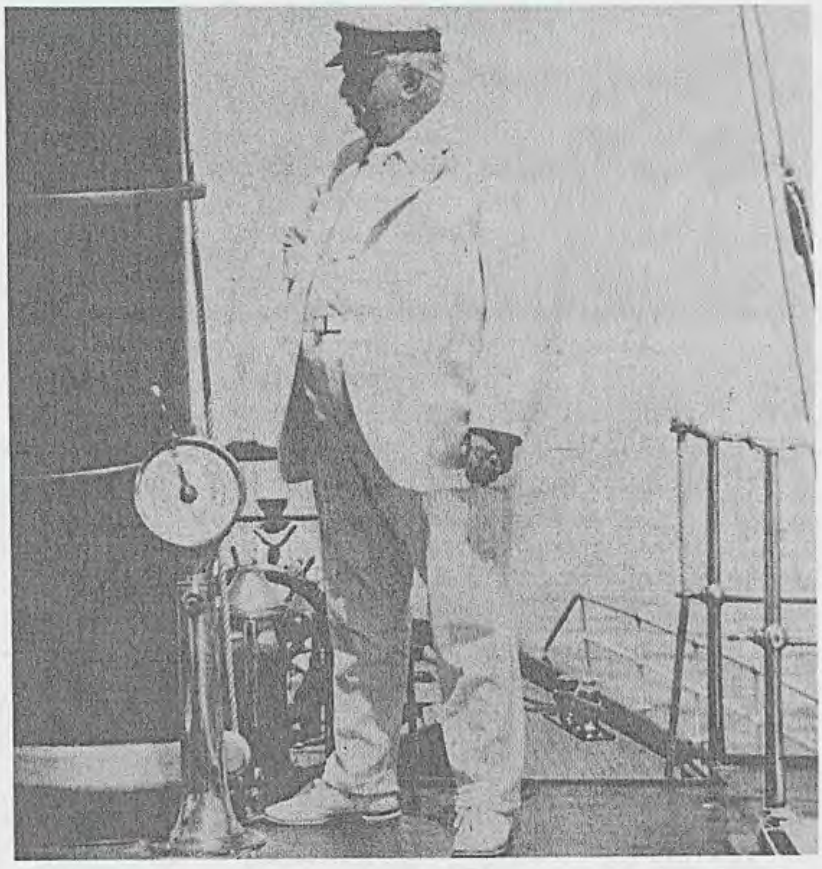
Thayer meticulously cultivated the culture of innovation, and in 1925 he ensured that this process would continue by selecting Walter S. Gifford as his successor.[74] Gifford was a Vail-trained and Vail-inspired telephone man. During his unusually long tenure as CEO (until 1948), Gifford further strengthened the R&D structure and deepened the organization's commitment to technological progress.[75] By the end of Gifford's presidency, the institutional

[72] See Hugh G. J. Aitken, *The Continuous Wave: Technology and American Radio, 1900–1932* (Princeton, N.J., 1985); and Reich, *Making of American Industrial Research*, 218–38.

[73] Neither M. D. Fagen, ed., *A History of Engineering and Science in the Bell System: The Early Years (1875–1925)* (1975), 52–56, nor Reich, *Making of American Industrial Research*, 182–84, nor Hoddeson, "Emergence of Basic Research," 541-42, discusses in any detail the managerial decision to organize the labs in this manner. For some insight into the problems that had arisen in handling R&D costs and the impact this seems to have had on the decision, see N. T. Guernsey to W. S. Gifford, 14 Dec. 1921; A. H. Griswold to E. S. Bloom, 25 Aug. 1922; C. G. DuBois to E. S. Bloom, 18 July 1923; and E. S. Bloom to H. B. Thayer, 24 March 1923.

[74] See H. B. Thayer to Henry S. Howe, 19 Dec. 1924. Thayer emphasized "the desirability of providing for a succession from within the organization." He said, "Since the election of Mr. Jewett on Tuesday, I can say that in our headquarters' organization there is either a younger or an older man technically qualified and experienced, who could carry on, at least temporarily, the work of any department if that department's chief were removed." He might have said, too, a man steeped in the values of Theodore N. Vail.

[75] Gifford, in fact, narrowed the focus of the Bell System, a change in policy that Thayer had started by selling Western Electric's international operations. Thayer and Gifford thus stressed economies of scale and system while curtailing efforts to achieve economies of scope. For example, Gifford took AT&T out of radio broadcasting and motion pictures, two businesses in which the firm had established strong technical positions.



Theodore N. Vail • Shown here in later life, Vail retired as president of AT&T in 1919. His ability to inculcate his vision of the Bell System throughout all levels of the firm and to build it into the company's research and development strategy allowed Vail to ensure the viability of that strategy for decades after his own departure. (Photograph reproduced from the Vail family's private collection.)

and cultural orientation of the business was so strong that the Bell System would hew firmly to the Vail strategy until the crisis of the 1970s.[76]

[76] See Peter Temin, with Louis Galambos, *The Fall of the Bell System: A Study in Prices and Politics* (New York, 1987), for an analysis of that crisis. See also Alvin von Auw, *Heritage and Destiny: Reflections on the Bell System in Transition* (New York, 1983); and Steve Coll, *The Deal of the Century: The Breakup of AT&T* (New York, 1986).

Conclusion

Theodore Vail's success in reorienting the Bell System's posture on technical innovation can be explained, I believe, by several characteristics of his managerial style. The industry was of course one with considerable technological potential. But it had that same potential before 1907, when Bell System service and R&D were sagging, as it did after Vail became president. Leadership mattered. It was important that Vail's corporate strategy arose out of his direct experience in operations; he was a hands-on manager who understood and was interested in the System's technology and its applications. Out of that experience, he derived a strategy that looked far into the future and measured progress in decades instead of years. His vision was well attuned to the developing market for telecommunications services in the United States. It was as well a coherent strategy for all of the constituent parts of the Bell System. Thus he centralized control of the technology and tightened the vertical integration of the System while leaving the operating companies (and for that matter Western Electric) considerable autonomy in dealing with other issues on a day-to-day basis. The Vail strategy was also holistic. It embraced all who worked in the System, from top management to the telephone operators, installers, repairmen, and mechanics.[77]

Vail's achievement was as much a socio-political as it was an economic or a technological phenomenon. Essential to the task was his selection of a new cadre of managers to implement and sustain the strategy of technological progress. They carried the word throughout the System, as did the conferences and new publications. Many of the values embraced in the Vail ideology—the service concept, for example—resonated with American social views, and this too helped to transform that ideology into a deep-set corporate culture. The Bell culture and the network mystique were significant factors in keeping the System innovative over the long term.

What the System sustained was a fruitful blend of adaptive and formative innovations. Vail created—and his hand-picked successors improved—a corporate structure capable of achieving that

[77] Richard S. Rosenbloom and Michael A. Cusumano find some of the same characteristics among contemporary executives who are successful in managing innovation: "Technological Pioneering and Competitive Advantage: The Birth of the VCR Industry," *California Management Review* 29 (Summer 1987): 51–76.

goal. As Frank Jewett noted, standardization was "a process of mediating the tension between innovation, on the one hand, and best accepted practice [that is, efficiency] on the other. . . . "[78] Western Electric's Engineering Department was the central "mediating" institution, and it was strategically situated, organizationally and geographically, to encourage both modes of innovation while preventing either one from overwhelming the other. In the modern Bell System, they appear for the most part to have been mutually supportive.

These developments in the Bell System and Vail's experiences as CEO suggest some conclusions about the economic theory of the firm, about the sociological theory of bureaucracy, and about the history of modern corporate management. Insofar as the theory of the firm is concerned, the Vail saga clearly is more compatible with recent developments in transfer cost (or market failure) analysis than with the traditional body of neoclassical thought. The traditional theory can be used to good effect in explaining certain important aspects of the Bell System's development prior to 1907. It as well helps explain why the 1907 shift in leadership and strategy took place; competitive pressure unseated a weak management and provided Vail with a strong incentive to chart a new course for the Bell System. But the theory of the firm provides little insight into the corporate transition that Vail engineered or into the long-run implications of that change. The transfer cost theory is more useful because the Bell System was vertically integrated, and the AT&T–Western Electric–operating company link played a crucial role, as we have seen, in the R&D process. But even the transfer cost theory provides little help in analyzing the dynamic aspects of Vail's new corporate strategy or many of the ideological and cultural components that helped to make it a success over the long term. As William Lazonick has suggested, we need a theory of the innovative firm.[79]

One aspect of that theory should be a recognition that internal

[78] Western Electric Company, *Manufacturing and Engineering Conference*, 1915. On the tension between innovation and efficiency, see Paul R. Lawrence and Davis Dyer, *Renewing American Industry: Organizing for Efficiency and Innovation* (New York, 1983), esp. 1–16, 238–90; and Louis Galambos, "What Have CEOs Been Doing?" *Journal of Economic History* 48 (June 1988): 243–58. On the balance between adaptive and formative innovations, I have benefited from Margaret B. W. Graham and Bettye H. Pruitt, *R&D for Industry: A Century of Technical Innovation at Alcoa* (New York, 1990).

[79] Lazonick, *Business Organizations and the Myth of the Market Economy*.

forces within the corporation can take the place of short-term market forces. These internal forces are dependent on effective corporate leadership in the development and implementation of a business strategy attuned to long-run market developments and to the firm's political and social setting. To be sustained, this sort of strategy must provide the organization with a compelling ideology rooted in values consistent with the firm's social, economic, and political environments. That ideology must be transformed into a corporate culture. It must be built into the firm's structure as well. The Vail strategy met those tests and achieved a power in shaping System development akin to those competitive pressures that are central to the economic theory of markets.

A similar conclusion can be advanced in regard to the social theory of bureaucracy. In that theory, public and private bureaucracies are usually distinguished because the former seldom face the sorts of market pressures that private bureaucracies encounter. But here too an effective organizational strategy seems capable of substituting for short-term market pressures as a means of encouraging innovation and effective performance on a day-to-day basis.[80] The structural components of bureaucratic authority are not inherently antithetical to either innovation or efficiency. Recognition of this possibility should help us analyze those government agencies that seem to function unusually well and to understand why regulation need not always produce unfortunate economic performances.

In relation to the history of modern corporate management, the Vail saga helps us see how business leaders of this era were able to link two sets of emerging institutions: the corporate combine and the scientific and engineering professions. These institutions, their personnel, and the special forms of knowledge associated with them provided Vail and other contemporary executives with opportunities, as well as with some of their thorniest problems. To solve these problems and to capitalize on their opportunities, they had to ease business through a major transition from a highly individualized style of innovation to the organized style that characterizes the economy—and indeed all aspects of

[80] Doig and Hargrove, *Leadership and Innovation*, breaks new ground in studying public bureaucratic behavior from a Schumpeterian perspective—hence moving the analysis of public administration closer to the position outlined here.

professional life—in the late twentieth century.[81] This was an extremely important transition, because the success of the economy in the twentieth century has depended in great measure on the ability of U.S. businesses to develop and implement technological and organizational innovations of the sort generated by the Bell System.[82]

Finally, this episode in business history suggests a new way of distinguishing routine corporate leadership from the type of innovative leadership that recasts corporate development over the long term. All chief executive officers perforce balance their firm's need for control of its relevant economic and political environments against its need for innovation and for operating efficiency.[83] The normal CEO devises and continually adjusts trade-offs in these three aspects of firm behavior. But a business leader like Vail shifts the basic nature of all three of the functions, creating a new equilibrium. When he is as successful as Vail was, his successors enjoy the luxury of routine corporate leadership (as did Thayer and Gifford). In the case of the Bell System, that quality of leadership would suffice for many decades to keep an innovative firm on the course originally charted in the years 1907–19 by Theodore N. Vail.

[81] This transition is discussed in Louis Galambos and Joseph Pratt, *The Rise of the Corporate Commonwealth: United States Business and Public Policy in the 20th Century* (New York, 1988), esp. 28–36, 71–99.

[82] Moses Abramowitz and Paul A. David, "Reinterpreting Economic Growth: Parables and Realities," *American Economic Review* 63 (May 1973): 428–39; Moses Abramowitz, *Thinking about Growth: And Other Essays on Economic Growth and Welfare* (New York, 1989).

[83] See Galambos, "What Have CEOs Been Doing?"

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The Telephone Industry

When the telephone was first invented, not everyone appreciated its importance. In fact, Western Union was at first offered the patent to this invention--but refused it. As Bell started to commercialize this invention, others began to see its potential. However, Theodore Vail, the President of American Telegraph & Telephone (AT&T), sought to avoid competition by establishing a new principle: that of a natural monopoly. He argued that it would be unwise to allow competition in the deployment of telephone networks, and permit a number of independent telephone systems to develop in the same city, each competing with each other: both for customers and for space to string their wires. The idea he proposed--that of a natural monopoly or *public utility*--was that there should be only one telephone company and that, since it would be a monopoly, it would be regulated by the government in order to protect the consumer.

Thus, although the actual service would be provided by a private company, the rates and practices in the industry would be regulated by the government. The company would apply to the government, who would then set rates for services and rules as to how the industry could function. This idea was accepted by the government.

On the federal level, the Interstate Commerce Commission and the Post Office Department (for the telegraph) first handled this, but in 1934 the Federal Communications Commission was established, and--among other things--was assigned the task of regulating telephone service at the national level. On the state level, public utility commissions (PUCs) were established to regulate state and local telephone service. The idea basically was to avoid duplication of effort, to encourage the orderly growth of the industry, and--through regulation--to protect the consumer.

As time went on, AT&T became not only the major industry player in the United States, but in fact, the largest company in the world. It was the only telephone company in most areas, and in those few areas where other telephone companies had come to exist, problems were often experienced with the interconnection of services, with equipment, and with other matters as well.

Through its monopoly control, AT&T came to dominate the three major areas of telephone service: local service, long distance service, and equipment. AT&T did not sell its telephones, it rented them. Both the long distance, or Long Lines, division of AT&T and the local telephone companies bought all their equipment from the AT&T subsidiary, Western Electric; they did not purchase equipment from any other manufacturers. AT&T did not allow its customers to attach devices to its network, such as extension phones, answering machines, or paging devices. Everything had to be rented from AT&T. As the electronics industry developed after World War II, people were still not allowed to attach these devices physically to the telephone network, but had to use a technology known as the induction coil to transfer signals to and from the telephone network electromagnetically.

In 1949, the government sued Western Electric and AT&T charging that they had monopolized the manufacture and sale of telephones and equipment (Civil Action No. 17-49). What the government sought was the divestiture by AT&T of Western Electric, the termination of the exclusive relationship Western Electric enjoyed with AT&T, and the total separation of telephone manufacturing from the provision of telephone service, among other things. However, there was little court activity on this matter between 1949 and 1956 when a consent decree was approved by the court. This decree did not include the divestiture of Western Electric. Instead, an injunction was issued which barred AT&T from engaging in any business other than the provision of common carrier communication services, and required Western Electric and AT&T to license their patents to anyone who wanted them upon the payment of appropriate royalties. Thus, there were substantial differences between what the government had sought in its 1949 complaint and what was actually provided by the consent decree (CA 82-0192, Transcript 1-24-56). The 1956 settlement would, at least, allow others to manufacture telephone equipment which they could actually sell to businesses and residential customers who could attach this equipment to AT&T's telephone network.

In 1959, the antitrust's subcommittee of the House Judiciary Committee held hearings on the 1956 consent decree (Report of the Antitrust Subcommittee of the House Committee on the Judiciary on the Consent Decree Program of the Department of Justice, 86 Cong. First Sess., Jan. 30, 1956). The Subcommittee's investigations revealed that AT&T was very active behind the scenes in trying to get the government to suspend its 1949 suit. When Eisenhower was elected president (the first Republican to become president in twenty years), AT&T renewed its efforts. As a result of AT&T's continuing lobbying of the Defense Department, the Secretary of Defense wrote a letter to the Attorney General asking him to end the 1949 litigation without requiring AT&T's divestiture of Western Electric. The Subcommittee, in its 1959 report, concluded that the Attorney General

manifested a willingness to have the Justice Department consider a token settlement and forego a decree consistent with the public interest--an attitude denoting partiality toward the defendants incompatible with the duties of this public office. (Subcommittee Report, 55)

The Subcommittee also uncovered the fact that AT&T had actually prepared the letter that the Secretary of Defense sent to the Attorney General.

As far back as 1935, the FCC had begun an investigation of the telephone industry. The results were released in 1939. The massive study of more than eight thousand pages which it published found that long distance rates were too high. As a result, the FCC had worked with many state utility commissions to get the local Bell companies to lower their rates.

As technology developed during the last few decades, a number of large businesses found it cheaper to obtain their own long distance links for telephone service, and eventually became interested in providing use of some of these links to the general public--in competition with AT&T. As a result of this, the facts about the 1956 consent decree which were revealed by the House Antitrust Subcommittee, and pressures from businesses and consumer groups, the government filed a new antitrust suit in 1974 against AT&T, Western Electric, and the Bell Labs. In this action, the government sought AT&T's divestiture of the Bell operating companies (the local telephone service providers), as well as the divestiture and disillusion of Western Electric. The government indicated that it brought the 1974 suit because the 1956 consent decree had not prevented AT&T from restraining competition in telephone equipment manufacture, nor protected against antitrust violations in long distance telephone service. AT&T pursued various legal actions to derail this suit, but pretrial action began in 1978, and a new settlement was proposed in 1982. That year the court, under Judge

Harold Green, held a hearing on the settlement and released what was officially called "A Modification of Final Judgment." In this 1982 consent decree, AT&T was required to divest itself of its 22 operating companies, the local service providers. AT&T would only be allowed to provide long distance service and would have to face competition from other long distance carriers, such as MCI and Sprint. Local telephone service was now to be provided by seven regional Bell operating companies (RBOCs). As far as long distance service was concerned, the customer at first had to dial a local number and connect with the competition's computer in order to use rival long distance services. Eventually, however, you were able to connect to these services simply by dialing 1, the area code, and then the number one was trying to reach--just as one did with AT&T.

As long distance service was disassociated from local service and competition emerged in the long distance field (AT&T still has a very large market share), long distance rates tended to decrease. However, local rates tended to *increase*. In addition, while it was cheaper to call between certain cities such as New York, Washington, and Los Angeles, service to rural locations and some less populated towns were more expensive.

It is expensive to maintain local telephone service with all the wiring and plant that must be maintained. Long distance service, on the other hand, is much less expensive to provide. Most of it is now carried by microwave and other technologies which are less expensive to operate. When AT&T had control of most telephone services, it was able to **subsidize** local operations by transferring to them some of the money earned from long distance services. Long distance services to less populated areas were also subsidized by service on more highly utilized routes. Some revenue from business service was also used to subsidize the rates of residential customers. Now that long distance service is offered by a separate company than local service, and on a more competitive basis, such subsidization has been discontinued. This is one of the reasons for the increase in the cost of local telephone service, even as long distance rates decrease--at least between major population areas. In addition, while businesses have been able to reduce their per unit costs, residential customers have not usually been able to do so. In fact, most residential customers throughout the United States have seen the cost of telephone service increase--rather than decrease--as had been the assumption with regard to the introduction of competition. And so, a number of public policy issues emerge with regard to subsidization, supposed competition, and telephone rates. Should some telephone service subsidize other service? Communication is so vital to our daily lives, to our ability to compete in business, and to our access to the political process. What attempts, therefore, should be made to ensure that telephone and other communication services are provided everywhere, and at reasonable rates? Or, on the other hand, should communication service be offered strictly on the basis of cost and the ability to pay--even if some areas, people, or businesses may be excluded?

One of the principles maintained thus far in the provision of telephone service has been that of **universal service**. That is, the idea that telephone service should be available to everyone for purchase. Of course, just because service is available has not meant that everyone can afford it, so that even today not all homes have telephone service, and in poor or remote areas--such as Indian reservations--the figure can go as low as 25 percent.

The concept of universal service has thus far only been applied to basic telephone service (often referred to as plain old telephone service, or POTS). There is no mandate to provide broadband communication services--such as interactive multimedia or video--on a universal basis. Thus, one of the early broadband multimedia services, ISDN (Integrated Service Digital Network), is still only available in certain areas.

A school or university which is located near a major commercial center may have access to such services, while another school or university not so located may not. What implication does this have for the **equality of educational opportunity**? As more information and video services emerge, will these only be available in certain locations? And will the rates charged for them be so high as to preclude access by smaller businesses and poorer residential customers and educational institutions? This is particularly important in the Information Age, when economic opportunities depend directly on computer and telecommunication skills.

Today, some competition has now been introduced in in-state long distance service. Moreover, since the seven regional Bell operating companies (RBOCs) have been doing extremely well financially, other companies are interested in getting into these local markets. In fact, many long distance, cable, and other companies are anxious to do this. The Telecommunications Act of 1996 is supposed to allow this. However, the reality of the situation is that the RBOCs are so entrenched and powerful that little progress has been made so far. In all of this, an important public policy issue arises: Should communication services for educational institutions, libraries, and medical purposes be provided at a discounted rate by the communication companies? The 1996 Act provides some provisions for this.

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The BELL TELEPHONE SYSTEM

by

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THE BELL TELEPHONE SYSTEM

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K-Q

in the United States which has worked any harder or more sincerely toward that common objective than has the management of the Bell System which I have closely observed in the last ten years. Yet in the long run, I am certain that the presence of the commissions is essential for three purposes: first, to obviate the necessity of the legislatures dealing directly with the utilities on rates and services; second, to give the public assurance that some agency besides that rendering the service is looking after its interests; and third, to provide a continuing tribunal to receive, hear and decide complaints. But with the operating groups and the regulatory groups both agreed that the main objective is the best service at the least cost, the points of difference ought to be within a relatively small range. That there will be points of difference is certain, both because people differ and because an estimate of what can be done in a given circumstance made by the people who are going to do the work is likely to vary from an estimate by those who are going to watch it being done.

State commissions as a political mechanism for regulating the intrastate telephone business can claim a very satisfactory record. The industry it has regulated has constantly increased and improved its service, the rates have been reasonable, the industry on the whole is prosperous enough to be in condition to continue to improve its service and to meet any local or national emergencies.

The record of state regulation indicates that it has been a very active force. In the sixteen years, 1925 to 1940, there have been rate changes affecting local charges for telephone service in practically every exchange of the Bell System.

A rough calculation of orders affecting Bell System companies, made by the different state commissions—including the District of Columbia—from the beginning of their jurisdiction to March, 1936, gives a total of more than 5,600. This shows a very considerable activity and indicates a fairly constant scrutiny of rates and adaptation to changing condi-

tions in the needs for service and operations in providing it. Of these 5,600 orders, about 2 per cent were litigated by the companies. A little more than 2 per cent reached court with some other plaintiff. The rest of the orders went into effect without an appeal to the courts. This whole record indicates a general and successful practice of cooperation between the companies and the commissions. Another check on the effectiveness of state regulation is the time taken by commission cases. There were between August, 1919 and June 30, 1936, about 950 orders affecting Bell System Companies. Of these, some 600 were completed within six months, about 150 more within a year, about 120 more within two years and some 70 took more than two years. The greater number of orders are issued without ever becoming formal commission cases. That fact does not imply that the companies have not had an opportunity to discuss the facts and issues with the commission. In practically all instances they do. But in most instances the orders are based upon informal discussion between the commission and the company and agreed to without formal hearings. Even when the companies originate a rate reduction, they usually go to the commission and talk it over with the commission and quite often it appears as a commission order. On the whole there is a constant and effective examination of rates going on almost all the time. It takes a lot of hard work and serious discussion on both sides, and proceeds with relatively little friction.

This kind of regulation gets results with a minimum of expense either to the commission or to the company and a minimum diversion of the company's efforts from operation to rate case arguments, and this is important because a company whose management is primarily tied up with a rate case is temporarily, at least, not functioning at its best on its main job.

However, while most state regulation goes on more or less in this manner there are exceptions.

In 1925, the beginning of the period under discussion, there were four rate cases on the docket of a kind which a student of regulation might well say were evidences of its ineffectiveness. One was a case which the New York Telephone Company had started in 1920 to increase rates to care for the increase in costs arising from the high price era following the war of 1917-18. The facts were in favor of the company, but in one way and another the case was delayed so that it never got the decision granting increases until 1930. As the company was endeavoring to raise rates neither reason, nor the actual facts, would indicate that the company was the cause of the delay.

Another was a case started by the commission in Ohio in 1924. Hearings were begun in 1925. As far as the company was concerned, the case was submitted to the commission on evidence and briefs in April, 1927. Against its protest the case was reopened by the Attorney General. It went through various vicissitudes after that and was finally settled by compromise more than ten years later.

A third was a more or less similar case in Michigan begun in 1919 and ended in 1936.

Both the Michigan and Ohio cases were delayed somewhat by the court decisions in the Illinois rate case. This, the fourth of the protracted cases, was begun in 1921. The longest delay in that suit was from the fall of 1925 until the fall of 1928, a delay entirely at the instance of the City of Chicago, and so stated by the court.

There have been criticisms of the Bell System for using the law's delays. In the kind of cases described above there have been law's delays aplenty and an almost total absence of that necessary aspect of full justice, which is swift justice. But as to who caused the delays I think the record is clear enough that the Bell System is far more sinned against than sinning. And this is natural, for there is nothing that interferes with the flexibility or effectiveness of management more than one

of these semi-perpetual rate cases. Many things which the management feels should have prompt decisions can't be decided while the rate case is going on, for they are affected by it; or the company can't tell what to do because it can't tell which way the case will come out. And all the while, telephone rates become more and more a political football, debated by candidates for office—the very thing which regulation was supposed to eliminate and which in most cases it has eliminated.

The Bell System does not like to go to court with rate cases. It does not like them while they are in court. It does not want to keep them there. If in the legal processes of trying cases the Bell System counsel put in too lengthy evidence, as some people claim, or in any other way contributed to the tedious length of these proceedings, I am certain that they would welcome any court's ruling for trial on a simpler basis. But once the companies come to the place where they feel they are forced to go to court, and also in the almost equal number of cases in which another party takes the case to court, it is the duty of the lawyers to present the case as fully as may be necessary to obtain final decision on the merits under the existing rules and practices of the courts in which they appear.

Generally speaking, the state laws provide that rates shall be just and reasonable, neither unreasonably low nor unreasonably high. There is quite a margin between these two extremes. The federal Constitution provides that no person's property shall be taken without due process of law, that is, it shall not be confiscated. The federal courts hold that fixing rates so low as to deprive the owner of the opportunity of earning a fair return on the fair value of the property would be confiscation. In Massachusetts the principle is followed that rates which would justify a prudent investor in putting his money in the business are proper rates. The Bell System policy says "earnings must be sufficient to assure the best

possible service at all times and to assure the continued financial integrity of the business."

If one looks over all these criteria for rates and earnings, it would seem that a rate base that just missed confiscation was too low, that the Massachusetts prudent investment and the Bell System's "financial integrity" bases would probably be about the same if judged by the same people, and that a reasonable rate of return for a utility ought not to be lower than the return for equal efficiency in the competitive field.

The knowledge, experience and point of view of the commission or court which is determining the matter have much more to do with the result than the theory which they accept. If the rates are cut until the company begins to show signs of financial distress, the assurance of good service will be threatened and a recession in business catching a company in that condition may cripple it for a long time. If the rates are set so low as to require the company to go in debt to get money, again it is on the downward path. The return which will satisfy stockholders in the long run, the cost of equity money, is the essential criterion.

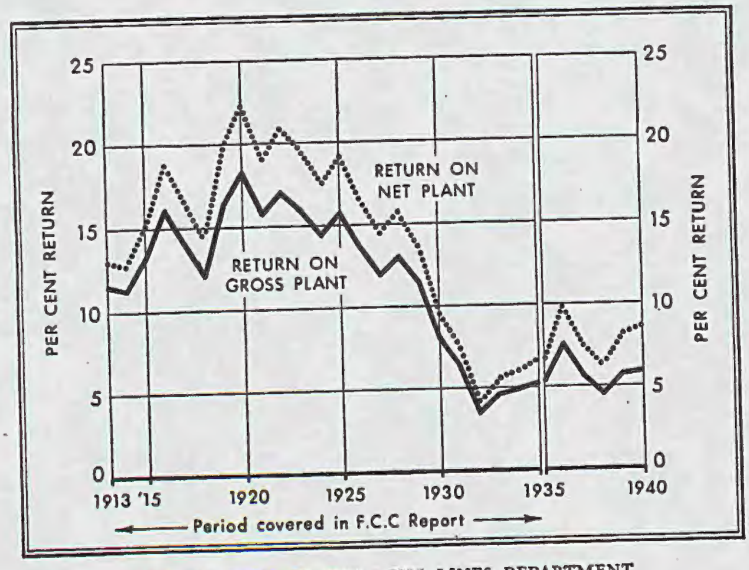
Before a Senate Committee in 1930, Mr. Gifford testified:

> So far as we are concerned in the Telephone business, so far as I am concerned in charge of trying to operate the business and give telephone service, these figures of rates of return and all of these legal terms are not of particular importance except when we do not earn what we need to earn to carry on the business. The thing that interests me is whether we have enough money and enough income to carry on this business which requires hundreds of millions of dollars of new money each year if we are going to go forward.

So far, under state regulation, the Bell System has met this test. State regulation of telephony has as good, if not a better, record than any other regulation in the United States. By the same token the Bell System has had as good or a better record of successful cooperation with regulation than any other industry. Either group can claim credit in varying de-

grees to suit itself. The element in the commissions which has made the system work has not been so much the theories on which it is based, or the technical processes of regulation, but the ordinary horse sense and business judgment of the commissions and their staffs on the simple question—is the company making too much or too little money to enable it and encourage it to give good service at the present and plan for better service in the future? The answer to that comes down to a matter of judgment.

American Telephone and Telegraph Company's long distance service under the Interstate Commerce Commission were reduced about as rapidly as they have been since that time, for the rate of technical improvement made it possible.



THE EARNINGS OF THE LONG LINES DEPARTMENT

This chart shows the annual per cent net return on Long Lines plant. The solid curve shows the return in relation to the plant investment (i.e., the plant as carried on the books at cost); the dotted curve shows the return on the plant investment after deduction of the reserve for depreciation of plant. On the left of the break in the grid, the chart is a copy of a Federal Communications Commissions chart. The curves on the right of the break show similar information for the subsequent period as reflected by the Long Lines Department records. From 1913 to 1934 the Interstate Commerce Commission had jurisdiction over the Long Lines Department. The Federal Communications Commission's report calls that the "nugatory" period of regulation. The 1935-1940 period has been under the jurisdiction of the Federal Communications Commission.

It may well be that what is called strict regulation of the interstate business from 1910 to 1934 would have been a very distinct disservice to the public. It is quite possible that

"strict" regulation might have produced the system prevalent in Europe where long distance connections habitually have many minutes—and sometimes even hours—delay, for that kind of service could have been made cheaper to begin with. The no-delay service is the result of long range planning and the availability of funds to finance it. It is quite possible that regulation which provides encouragement may produce better and cheaper service in the long run than a process of seeing how close a business can be kept to confiscation. If regulation is to be a success and the regulated industries are to be strong and serviceable both normally and in emergency, regulatory bodies must consider what it is that encourages men and organizations to function.

From the time the Federal Communications Commission took over the regulation of the interstate telephone business through 1940, there have been five reductions in long distance telephone rates. Three of these were made by the American Telephone and Telegraph Company, as it had done previously when under the jurisdiction of the Interstate Commerce Commission, and two after discussions initiated by the Federal Communications Commission, in the manner frequently followed by state commissions in their dealings with the operating companies. There have also been several reductions in the interstate rates of associated companies.

The Federal Communications Commission also made some changes in the standard accounting practices which had been developed by the Interstate Commerce Commission.

The Federal Communications Commission under the new statute departed from the "nugatory" attitude of its predecessor in two other matters. The language of the 1934 act covering telephone regulation followed the act covering railroad regulation. In the latter act there was a provision that no company could build a new interstate line without the Commission's agreeing that it was in the public convenience or necessity. The purpose of this was to limit un-

One Policy
One System
Universal Service

THAT the American public requires a telephone service that is universal is becoming plainer every day.

Now, while people are learning that the Bell service has a broad national scope and the flexibility to meet the ever varying needs of telephone users, they know little of how these results have been brought about. The keynote is found in the motto—"One policy, one system, universal service."

Behind this motto may be found the American Telephone and Telegraph Company—the so-called "parent" Bell Company.

* * * *

A unified policy is obtained because the American Telephone and Telegraph Company has for one of its functions that of a holding company, which federates the associated companies and makes available for all what is accomplished by each.

As an important stockholder in the associated Bell companies, it assists them in financing their extensions, and it helps insure a sound and uniform financial policy.

* * * *

A unified system is obtained because the American Telephone and Telegraph Company has for one of its functions the ownership and maintenance of the telephones used by the 4,000,000 subscribers of the associated companies.

In the development of the art, it originates, tests, improves and protects new appliances and secures economies in the purchase of supplies.

It provides a clearing-house of standardization and thus insures economy in the construction of equipment, lines and conduits, as well as in operating methods and legal work—in fact, in all the functions of the associated companies which are held in common.

* * * *

Universal, comprehensive service is obtained because the American Telephone and Telegraph Company has among its other functions the construction and operation of long distance lines, which connect the systems of the associated companies into a unified and harmonious whole.

It establishes a single, instead of a divided, responsibility in inter-state connections, and a uniform system of operating and accounting; and secures a degree of efficiency in both local and long distance service that no association of independent neighboring companies could obtain.

* * * *

Hence it can be seen that the American Telephone and Telegraph Company is the active agency for securing *one policy, one system, and universal service*—the three factors which have made the telephone service of the United States superior to that of any other country.

American Telephone & Telegraph Company

October 27, 2006

Joint FTC/DOJ Antitrust Division Business History Hearing, Oct 26, 2006

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My remarks for the panel discussion will focus on four aspects of the contribution business history has made and perhaps can make to our understanding of the antitrust policy of the United States: I will first discuss briefly the work of Alfred D. Chandler, Jr., certainly the world's most eminent business history; second, I will consider the manner in which business history found itself linked with recent developments in economics and in managerial studies; third, I will mention the two interrelated developments that many analysts believe have recently had the most dramatic impact on the U.S. economy, that is globalization and the third industrial revolution. Finally, I will suggest some of the ways these academic and economic phenomena can be related to the antitrust case against AT&T and subsequent developments in telecommunications in this country.

* * *

When Alfred D. Chandler, Jr., was launching his long, fruitful career as a business historian, the dominant historical paradigm for understanding the role of big business in American history was provided by Matthew Josephson, author of *The Robber Barons.* Josephson's popular book, which was published in the depths of the worst depression America had ever suffered, focused on the scoundrels who ran and robbed their corporations and the American people. In the years that followed, business historians had been attempting without much succcess to change that historical construct by demonstrating that the scoundrels were really good guys who were builders, not robbers. Chandler set out to develop a new context and questions for the subdiscipline of business history. By the time he wrapped up his active career, business history had been converted to a new and far more successful paradigm, in large part because of the work Chandler, his students, and his followers had done.[1]

What, then, are the defining elements of the Chandler paradigm and what were the most important intellectual currents shaping his work? The two dominant

intellectual currents came from sociology and from political economy. The sociology was the structural-functional equilibrium theory of Talcott Parsons, a construct that built on the work of Max Weber, the first great analyst of modern bureaucracy. The political economy came from Joseph A. Schumpeter, whose dynamic theory of capitalist growth focused on the heroic entrepreneur, the successful innovator who introduced new technologies, new sources of raw material, new markets or new organizational forms. Seeking his own rewards, the entrepreneur reshaped society through the process of creative destruction: new and more efficient ways of doing business destroyed older, less efficient enterprises, Shumpeter said, and the entrepreneurs drove capitalism ahead in great surges of change and growth.

Chandler built upon but reconstructed these two bodies of theory. He used structural-functional ideas to build up a dynamic, comparative history of the role of large corporate enterprise in capitalist progress from the nineteenth century through the end of the twentieth century. He used the idea of Schumpeterian entrepreneurship, but he looked to organizational capabilities rather than the heroic individual as the primary source of change in the second industrial revolution. The organizations that were successful over the long-term, he said, were those that made the vital three-pronged investments in an effective managerial hierarchy, in mass production, and in mass distribution. Chandler left no doubt about the positive impact of these developments: "the modern industrial enterprise played a central role in creating the most technologically advanced, fastest-growing industries of their day. These industries.. were the pace setters of the industrial sector of their economies--the sector so critical to the growth and transformation of national economies into their modern, urban industrial form."[2]

* * *

The Chandlerian construct of business history became linked to developments in two other disciplines concerned with business and especially with the types of large enterprises Chandler studied. In economics, Richard R.Nelson and Sidney G. Winter developed *An Evolutionary Theory of Economic Change* in the early 1980s, a theory that spawned a neo-Schumpeterian school of analysts. Their effort to develop a dynamic model of long-term economic change carried them from theory into history, from a discussion of national innovation systems into the sources of industrial leadership. This left them close to the context in which Chandler was working, as did the work being done in transactions cost economics by Oliver E. Williamson and others. Williamson, like the evolutionary economists, was introducing historically particular elements to theory, pushing it toward Chandler's analysis of the crucial role of vertical integration in the rise of the modern firm. Paul David's work on path dependency had a similar impact.

All that I'm suggesting here is that the context in which scholars placed and analyzed big business was changing in important ways. The comparative static analysis of industrial organization theory was co-existing with dynamic styles of analysis with important elements of place- and time-related history. In an effort

to answer Ronald Coase's question, "Why Are There Firms?" some economists were developing a new perspective on the modern corporation, a perspective that narrowed the gap between economics and history.[3]

Similar, and related changes were taking place in management studies. Management scholars were devoting substantial attention to the environment external to the firm and to the aspects of the environment and the firm's capabilities that yielded effective innovation over the long-term. The capabilities literature was linked very closely to business history, as were the new studies of how firms respond to drastic changes in their technological context. This latter work added something new to the Chandlerian concept of business history insofar as it gave substantial attention to failure. Chandler's focus had always been on successful firms (called "Chandler firms" at the Harvard Business School). The work in management, in the history of technology, and in the political history of the administrative state also paid more attention than Chandler did to the political context in which modern corporate business evolved.

* * *

Meanwhile, out beyond the academy and the academic research being done by historians, economists and management scholars and others, the world was rapidly changing. With the breakdown of the Bretton Woods settlement and the decisions by the leading OECD countries to foster relatively free trade, the world entered a second phase of globalization. Many American industries had been facing intense competition before this happened but the pressure on these industries to change or lose market share (or worse) increased sharply in the 1970s. The United States experienced a dramatic phase of competitive destruction that didn't seem to have a creative element - at least not for the American rustbelt.

* * *

That, I believe, is the context in which we need to place the antitrust case against AT&T in the 1970s and the subsequent developments that have taken place in telecommunications. The Bell System seemed to have done all of the right things according to the Chandlerian paradigm. It had made the three-pronged investments, very heavy investments, in the provision and distribution of its basic service and had, to boot, developed a well-trained and well-indoctrinated corp of professional managers. The Bell-Heads had as well created a powerful social ethic to accompany the network mystique that pervaded the enterprise. Bell Labs was a marvelously creative institution that had, in fact, developed crucial elements of the technology that gave rise to the third industrial revolution of the so-called information age. In the 1970s, when American productivity increases were drifting toward zero, the Bell System continued to experience healthy increases in productivity.

That was a pretty impressive record and it helps one understand today why AT&T's leaders ignored a vital part of their own history - the part that wasn't in

the Chandler paradigm. When the modern Bell System was being created in the years before World War I and during its subsequent history, AT&T had managed to maintain a powerful monopoly in a nation opposed to monopoly by compromising with public authority. But AT&T's leadership in the early 1970s forgot about that, threw down a gauntlet to the U.S. government and its major competitor, and ended up mired in a series of incredibly expensive antitrust suits. Losing the federal case in Judge Greene's court, AT&T settled out of court by breaking up the Bell System.

At that crucial point in the development of U.S. telecommunications, AT&T's leaders and the government shifted gears and paid *too much* attention to history and *too little attention* to the changes taking place in the global economy. The settlement opted for the Chandler vertically integrated model, with AT&T keeping the Western Electric business and Bell Labs, while sacrificing the Baby Bells and the local networks. AT&T gave away the mobile phone business it had created and looked forward to a new career as a competitive long-distance firm. Underestimating the changes that would have to take place from the top to the bottom of the organization to become an efficient competitor, AT&T struggled and failed to implement successfully the transition to competition and the firm's strategy of convergence. The market worked, and AT&T recently had its own redezvous with creative destruction.

Perhaps I shouldn't be so harsh with AT&T's leaders because the government seems to me to have been similarly unmindful of the changes taking place in the global economy in the 1970s and 1980s. There was no consideration in the antitrust case of the Bell System's efficiency; there was no consideration of the innovations Bell Labs had produced; there was no consideration of the vast market for telecom equipment that was being thrown open to foreign suppliers; there was no consideration of whether deregulation might not serve the public interest better than a structural settlement under the Sherman Act. There was, instead, a dedication to a policy that was rooted in a past when the most important market was the American market, when American public policy could be framed almost entirely in terms of the domestic economy.

* * *

Subsequent developments in telecommunications suggest, however, that in this historical example, the United States government seems to have learned faster than did a large integrated corporation or the subdiscipline of business history. The United States changed its antitrust policy in the 1980s. There were no more structural cases under Section 2 of the Sherman Act until the Clinton Administration launched its attack on Microsoft. Fortunately, from my point of view, attention to global competition and the need for the United States to remain competitive in the world economy appears to have modified even the Microsoft settlement in ways suited to the world in which we now live.[4]

This is a different world from the one at the heart of Chandler's history, and business historians have recently begun to come to grips with that transition. The work of Naomi Lamoreaux, Dan Raff, and Peter Temin is at the forefront of that

effort. As their new synthesis of business history suggests, this is a world economy rapidly being reconstructed by information technology and intense global competition. Disintegration is now almost as common as vertical and horizontal integration were in the second industrial revolution.

So my conclusion is two-fold: First, don't ignore your history or you may suffer as the Bell System did (and Bill Gates almost did); and second, don't get locked into an historical model when major changes in political economy are taking place and new ideas are needed. Both conclusions bring me back, I believe, to an evolutionary model, broadly conceived.

FOOTNOTES

1. A Harvard classmate of John F. Kennedy, Chandler returned from World War II service to start graduate training in history, first at the University of North Carolina and then at Harvard. He published his dissertation on *Henry Varnum Poor* in 1956 and his more influential study of *Strategy and Structure: Chapters in the History of theIndustrial Enterprise* in 1962. He has said that his last business history was *Shaping the Industrial Century: TheRemarkable Story of the Evolution of the Modern Chemical and Pharmaceutical Industries,* published in 2005. He is now working on a family history. In the interest of transparency, Chandler was my second mentor.

2. Alfred D. Chandler, Jr. (with the assistance of Takashi Hikino), *Scale and Scope: The Dynamics of Industrial Capitalism* (Cambridge, 1990), 593.

3. Ronald H. Coase, "The Nature of the Firm," *Economica,* 4 (1937), 386-405. As Christopher D. McKenna, *The World's Newest Profession: Management Consulting in the Twentieth Century* (New York, 2006), points out, Coase did not state the question exactly this way, but this formulation accurately catches the meaning of Coase's important work.

4. The DOJ and FTC also should be complemented for the brilliant, innovative manner in which the "prisoner's dilemma" strategy has been employed to uncover illegal cartels.

date ?

Competition in a Network Industry: The Telephone Industry, 1894–1910

DAVID GABEL

The re-emergence of AT&T as the dominant firm in the telephone industry resulted from its adopting a predatory response to entrants. AT&T's strategy was effective because government regulations and capital market imperfections provided the incumbent with a first-mover advantage that prevented challengers from entering simultaneously in all markets.

Although turn-of-the-century Americans worried a lot about predatory behavior by large-scale businesses, most present-day scholars argue that it was both irrational and rare for large firms to engage in predation. Much of the current scholarship on the extent and rationality of predation can be traced to John McGee's seminal study of predatory pricing by Standard Oil. McGee focused on the Supreme Court case *Standard Oil v. U.S.* because the allegedly predatory practices detailed there played a large role in motivating subsequent legislation and court rulings.[1] Based on his reading of the evidence, McGee concluded that Standard Oil did not drive rivals out of business by initiating price wars and that such predation would have been an irrational strategy for the firm to pursue. He pointed out that by merging with its rival instead of cutting prices, Standard Oil could earn higher profits. Because predation involved an unneeded sacrifice of profits, merger was the preferred strategy. Theoretically, therefore, it seemed unlikely that dominant firms would pursue aggressive pricing strategies.[2]

Despite the dominant influence it has attained, McGee's argument can be challenged on several grounds. First, antitrust laws may preclude

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[1] *Standard Oil v. U.S.*, 221 U.S. 1 (1911).

[2] McGee, "Predatory Price Cutting," p. 137. McGee's influence on the current state of the law is reflected in the Supreme Court's assertion in *Matsushita Electric Industrial Co. v. Zenith Radio Corp.* that "predatory pricing schemes are rarely tried, and even more rarely successful." 475 U.S. 574, 589 (1986).

the merger option. Second, the incumbent may find predation profitable because, by acting aggressively, it can inflict enough financial harm on a rival to yield savings in acquisition costs in excess of its short-term losses. Third, as game theorists have argued, McGee's analysis ignores the strategic value of reputation. A firm supplying multiple markets may be willing to incur losses in one market in order to establish a reputation as an aggressive incumbent. An aggressive response to a first entrant can signal to potential rivals that entry will be unprofitable. It thus can deter entry in other markets and increase future profits.[3]

This article uses the history of the American telephone industry to critique McGee's view of predation. The industry's first firm, the American Telephone and Telegraph Company (AT&T), has been charged with predatory pricing on a number of occasions, but the cases have never been fully litigated.[4] Nevertheless, the general consensus of business historians is that AT&T did not make significant use of predation and that it retained control of the industry during the competitive period 1894 to 1910 because of its superior long-distance network and quality service.[5] These researchers have argued that AT&T's rivals focused on providing inexpensive local service, but this conclusion is based on inadequate research. Many of the entrants, here collectively referred to as the Independents, were in fact committed to providing quality service and building a long-distance market. AT&T's leaders knew this. Indeed, they were well aware that superior service was available from the Independents in certain areas of the Midwest and the West Coast. Both Frederick Fish, AT&T's president during the height of the competitive era, and his successor, Theodore Vail, acknowledged that competition resulted largely from AT&T's failure to develop its markets fully and to provide quality telephone service. In letters to Bell Operating Company executives, Fish frequently emphasized the need to improve the service: "We must give good service and must do everything that is necessary to have good service. Most of our opposition troubles are due, not so much to rates as to two other things,

[3] Ordover and Saloner, "Predation," pp. 350–56; Yamey, "Predatory Price Cutting," p. 129; and Burns, "Predatory Pricing," p. 266.

[4] Koller, who has undertaken the most comprehensive study of federal antitrust cases against alleged predators, did not consider cases in which a consent decree had been reached by the parties. Koller, "Myth," p. 111. The three federal cases filed against AT&T all ended in consent decrees.

[5] Chandler, *Visible Hand*, p. 202–3; Wasserman, *Invention*, pp. 121–22; Langdale, "Growth," p. 145; Federal Communications Commission, *Investigation*, p. 130; and Lipartito, *Bell System*, p. 93, and "System Building," p. 328. Weiman and Levin, "Preying," argue that AT&T attempted predatory pricing in the South but found that its market could be best secured by other means—for example the extension of its network and the use of administrative processes to prevent new entrants from obtaining franchises. In this article, I focus on the entrants' more successful efforts in the Midwest. The extension of AT&T's toll network was not by itself a sufficient means for eliminating AT&T's rivals outside the South. In the Midwest, AT&T's rivals quickly secured a large share of the market despite the company's already extensive toll network.

namely, bad service and not covering the field." Even where AT&T had successfully developed the market, poor service continued to endanger its position.[6]

In this article I argue that the demise of the Independents, especially in the Midwest, owed more than anything else to predatory actions by AT&T. AT&T chose to use predation rather than acquisition to control the industry because aggressive response to entry in one market deterred potential rivals in other markets. AT&T's management realized that if it pursued the acquisition strategy suggested by McGee, the compensation provided to rivals would encourage future entry.[7] In order to deter entry, therefore, AT&T set prices at predatory levels in its rivals' strongest markets. The strategy succeeded, and the rivals were forced to sell their assets at a loss.

WHAT CONSTITUTES PREDATION?

Various economic and legal tests exist for predation. Their principal feature is that the predator's action is intended to drive an equally efficient rival out of business and to scare off potential entrants.[8] The test of predation often used by the courts is to evaluate the relationship between price and either the marginal, average-variable, or total cost of production. Many analysts have pointed out, however, that cost tests are difficult to implement or misleading because the data needed to calculate the cost of production are difficult to obtain and subject to arbitrary cost-allocation decisions. More important, a price below marginal, average-variable, or total cost of production may have nothing to do with predation.[9] For example, at the start of this century, AT&T's managers believed that residential service should be priced at a rate that was less than the direct cost of service. This "loss" was more than made up by the higher charges that could then be set for business lines.[10] This below-cost price is not an example of predation because the intent was to bring new customers onto the network and thereby raise the value of service to existing customers.

Typically, predation takes the form of a temporary price reduction; but firms can also employ other exclusionary acts, such as predatory use of the administrative process and noisy advertising. By conveying to an entrant that it will have to incur large legal expenses or undertake an expensive advertising campaign, the incumbent raises the rivals pro-

[6] American Telephone and Telegraph Corporate Archive [hereafter AT&TCA], Fish/Burt, Feb. 14, 1903, Presidential Letter Books [hereafter PLB], vol. 26 (quote), and Fish/Glass, Mar. 23, 1903, PLB, vol. 27; and Danielian, *AT&T*, p. 58.

[7] AT&TCA, Fish/Pettengill, Apr. 21, 1902, PLB, vol. 23.

[8] See, for example, Tirole, *Industrial Organization*, p. 373; and Bork, *Antitrust Paradox*, p. 159.

[9] Bork, *Antitrust Paradox*, p. 154; and Tirole, *Industrial Organization*, p. 373.

[10] AT&T, "Conference."

spective costs and thus reduces the likelihood of entry.[11] Regardless of the method, by causing financial harm to rivals, the predator sends a signal to its existing and future rivals that rivalry will be costly to all parties.

THE STRATEGY OF THE INDEPENDENTS

In 1879, after a short period of competition with Western Union, the Bell System gained exclusive control of the telephone industry. Until Alexander Graham Bell's patents expired in 1893 and 1894, AT&T focused on serving the business community in the nation's larger cities. AT&T decided that because the marginal efficiency of capital was higher in more densely populated markets, it would largely ignore rural areas, towns, and smaller cities.[12]

The larger cities were served by AT&T licensees, called Bell Operating Companies. In exchange for the exclusive right to develop the market in a local region, the operating company agreed to provide the parent with 35 percent of its stock, purchase its equipment from AT&T's subsidiary Western Electric, interconnect with AT&T's long-distance network, and allow the parent company to monitor its engineering practices.

During the monopoly era, AT&T's strategy was quite profitable; Robert Bornholz and David Evans have estimated that the firm earned an average annual return on investment of 46 percent.[13] When the patents expired in 1893 and 1894, entrants were attracted to the industry because of the high profits and because AT&T had ignored less densely populated markets and the residential community. Promoters believed that profitable opportunities were available in undeveloped markets as well as those that Bell was already serving. The entrants felt that they would do well in the large cities because of the incumbent's high prices relative to cost, and because customers were dissatisfied with the quality of service on Bell's network.

Like AT&T, the Independents were committed to linking the different exchanges together through a toll network. But the entrants' approach to building a network was significantly different than AT&T's. The founder of one of the leading Independent journals noted that "the Bell people worked from the top down and the Independents from the bottom up."[14] The Independents resolved rate and engineering questions at state and national trade association meetings. At these meetings, voting was controlled by the local exchange companies, rather than the management of a national holding company. No party had the

[11] Salop and Schiffman, "Raising Rivals' Costs," p. 267.
[12] *Wisconsin Telephone News*, 1 (Dec. 1906), p. 1; and MacMeal, *Story*, p. 24.
[13] Bornholz and Evans, "Early History," p. 25.
[14] MacMeal, *Story*, p. 24.

power to force the numerous Independent exchange companies to adopt a particular practice.

In contrast, decision-making power for AT&T resided at its New York headquarters. By the start of the twentieth century, AT&T had increased its ownership in most Bell Operating Companies to over 50 percent. Its voting power allowed the parent company to standardize procedures more rapidly than the Independents. Nevertheless, there were drawbacks associated with this vertical organizational structure. Independent officials were more aware of local conditions and had greater latitude in adopting policies that met the needs of their communities. As AT&T consultant George Anderson pointed out, local control had been "a substantial factor making for the success" of the Independents.[15]

The Independents did especially well in meeting the demand for telephony in markets that had been neglected by Bell. With the expiration of Bell's patents, farmers began to purchase telephones from any one of a large number of new manufacturers of telephone equipment. Thereafter, the telephone quickly became a popular item on the farm. It served two general functions: it reduced the level of social isolation and provided a means for quickly contacting merchants in nearby towns.

Between 1894 and 1899, AT&T turned down the request of the companies that served rural America for interconnection with its networks, a policy that encouraged entrepreneurs to establish competitive exchanges. Wholesalers, millers, doctors, and other businessmen who worked in large cities realized that their trades would be aided by establishing an Independent exchange that could reach markets overlooked by AT&T. Such merchants and professionals provided an important source of local capital for the companies that competed with Bell.[16]

Bell's rivals knew that if they did not construct a long-distance network, they would be unable to attract customers away from Bell or to retain their customers' patronage. The Independents believed that toll service was highly valued by the business community, and they were keenly aware that their own connections to smaller towns and rural communities provided a competitive advantage in local markets. But in order to secure the patronage of business customers who were engaged in transactions over a larger region, they needed to construct a toll network that rivaled Bell's in breadth.[17]

[15] Anderson, "Telephone Situation," p. 67; and Whitney, "Report," p. 21.

[16] AT&TCA, Allen/Fish, Feb. 16, 1903, Allen Letter Books [hereafter ALB]; and Johnson, "Experience," p. 580.

[17] Wisconsin State Historical Society [hereafter WSHS], Dane County Telephone Papers [hereafter DCTP], Brown/Harper, Mar. 30, 1898, and Twining/Harper, Oct. 24, 1899; and AT&TCA, Jackson-French, Jan. 16, 1897, box 1277.

The Independents did construct regional networks. These networks were linked together. By 1904, for example, there was Independent toll service between Cleveland and St. Louis. The clarity of conversation on these long-distance networks, however, was often inferior to Bell's, and the lack of trunk lines meant that it took longer to set up a toll call on the Independents' systems. Clarity was inferior because no central organization had dictated construction standards. Consequently, the interconnecting equipment was not always compatible.[18] The Independents tried to solve this problem through their regional and national trade associations, the same mechanism used by the railroads. During trade association meetings, some of the Independents' leaders recommended that high-grade construction procedures be followed. High-quality equipment was recommended and installed because the predominant users of the network, business customers, were more interested in obtaining reliable, rather than cheap service. By 1906, the Independents had succeeded in adopting and implementing uniform standards within their regional networks. For calls over approximately 200 miles, however, the problem of standardization had not been fully resolved.[19]

Capital was needed for the construction of the high-quality trunk lines that could expedite the completion of long-distance calls. The Independents believed that the funds should be raised either by regional toll companies or by a national organization that owned all the regional toll lines. But the toll companies experienced trouble raising capital. Much of their stock was owned by local telephone companies; but despite their recognition of the necessity for constructing a toll network, these companies faced financial constraints that prevented them from making large subscriptions.[20]

Poor accounting practices were responsible for some of the local Independents' financial problems—some of the exchange companies made inadequate allowances for depreciation—but the effects of AT&T's predatory actions were more important.[21] By forcing its rivals to take losses in local markets, AT&T damaged entrants' ability to fund the construction of their toll network or to finance expansion into new markets. For example, AT&T feared that an Independent stronghold in upstate New York would serve as a lever for gaining entry into New York City.[22] Thus, the upstate Bell Operating Companies operated at a loss in order to serve as a "buffer" for the company's profitable New

[18] AT&TCA, Allen/Fish, Dec. 3, 1903, and June 4, 1904, ALB.

[19] "Report of the Fourth Annual Convention"; *Western Electrician*, 2 (Mar. 1, 1902), p. 148; and Nichols, "Result," p. 17. The national trade association meetings were only attended by the larger Independent companies. Because both large and small companies attended the regional meetings, it was within this forum that the most progress was made in establishing uniform operating and construction procedures.

[20] WSHS, Harper/Brester, May 12, 1899, DCTP; and *United Telephone Voice*, May 1921.

[21] Mathews, "Truth," pp. 305–6.

[22] AT&T, "Conference," p. 226.

York City monopoly. Part of the payoff for this strategy came in 1907 when the Independent in Rochester defaulted on its bonds and agreed to sell AT&T its properties.[23] AT&T's acquisition reduced the value of the Independents' properties at nearby exchanges. As a network industry, the strength of each Independent was dependent on the number of customers that could be reached on the Independents' network. The importance of network connections is reflected in the decline of a neighboring telephone company's stock after the Independent in Rochester was acquired by Bell. The Federal Telephone Company of Buffalo, a holding company that operated in Buffalo and elsewhere, saw its stock fall from $33 to $13 per share when the Rochester purchase was announced.[24]

The harm done to the Buffalo Independent resulted in part from the Independents organizational structure, in particular the lack of common ownership. An Independent company may have found it in its best interest to sell its properties to Bell, even though the action was harmful to other Independents. The Independents were aware that if exchanges such as Buffalo and Rochester were under common ownership, no one Independent could take action that was in its best interest but harmful to the general interests of the group. They therefore made several attempts to consolidate their operations under one management and to organize an independent, nationwide competitive communications system.[25] The most successful effort was made in 1909, but, as I describe in the next section, it was eventually halted by the predatory behavior of AT&T. AT&T's aggressive pricing was effective because some of its markets were partly protected by barriers to entry. These protected markets helped finance the incumbent's short-term losses in more competitive markets. In the following sections, I describe the source of the barriers—regulatory rules and capital market imperfections that impeded the Independents efforts to establish a ubiquitous network.

COMPETITION IN THE MIDWEST

As shown in Table 1, the Midwest was the region where the Independents met with the greatest success. Central Union, one of AT&T's operating subsidiaries in the Midwest, provided service in Indiana, Ohio, and Illinois. Although its service territory included most areas in these states, Chicago, Cincinnati, and Cleveland were served by other Bell Operating Companies.

Regional data underscore the strength of the Independents in the service territory of Central Union. In 1902 Central Union's network

[23] AT&TCA, Vail/Winsor, Mar. 26, 1909 (quote), "Proposed Consolidation," box 47; and *Telephone Securities Weekly*, Apr. 13, 1907.

[24] *Telephone Securities Weekly*, Apr. 7, 1907.

[25] Federal Communications Commission, *Investigation*, pp. 130–32.

TABLE 1
BELL AND INDEPENDENT MARKET SHARES, 1907
(percentages)

Region	Bell	Independents	Independents Affiliated with Bell[a]	Bell + Affiliated Independents
United States	51.2	48.8	13.7	64.9
North Atlantic	74.9	25.1	3.3	78.2
South Atlantic	57.2	42.8	7.4	64.7
North Central	33.8	66.2	20.5	54.3
South Central	50.2	49.8	18.6	68.9
Western	71.0	29.0	6.7	77.7

[a] These were Independent stations that exchanged service with the Bell System.
Source: U.S. Department of Commerce, *Telephones and Telegraphs, 1907*, table 10, p. 23.

connected one-third as many subscribers as the Independents. At the end of 1908 it included only 48 percent of all subscribers in its service territory.[26] By 1906 most of the major Independent exchanges (for example Toledo, Cleveland, and Indianapolis) were controlled by a holding company, the United States Telephone Company, whose corporate structure was similar to AT&T's. United States provided long-distance service in Ohio and Michigan and controlled the New Long Distance Company of Indiana. New Long Distance provided toll service in the Hoosier State and, along with United States Telephone, owned approximately 20 local exchange companies.[27] United States's trunk lines connected exchanges in Ohio, Michigan, and Indiana with other regional Independent systems. For example, a subscriber in Indianapolis could connect with the Federal Telephone System to reach Buffalo or with the Kinloch System to reach St. Louis.

The initial success of the Independents in the Midwest was largely due to four factors: improved local service, reduced price, more extensive regional connections, and the public's inclination to support a local firm.[28] Confronted with the Independents' initial success, Central Union attempted to retard its rivals' expansion by adopting rates that the firm's directors believed were "below the cost of doing the business." Central Union operated at a loss in order to protect AT&T's network.[29] According to L. N. Whitney, a superintendent of Central Union and a member of its board of directors, Central "cut [its] rates" as part of a general strategy "to cause every dollar invested in Independent property to be lost." Whitney added that these losses

[26] AT&TCA, Minutes of Director's Meeting, Central Union Telephone Company, Mar. 18, 1908, p. 264; and *Read et al.*, Richardson/Dubois, Jan. 22, 1909, in "Competition, Opposition, Mergers, Connections with Independents," p. 141.

[27] New England Telephone, *Telephone*, pp. 45–49.

[28] Whitney, "Report," p. 15.

[29] AT&TCA, Minutes of Director's Meeting, Central Union Telephone Company, Jan. 20, 1897, p. 237 (quote); and *Read et al.*, "Opinion Rendered by Judge William E. Dever," Jan. 20, 1917 slip. op., p. 41.

served "as a warning to other investors, who might dare to invade the field of the Central Union monopoly."[30]

In formulating its competitive response in the Midwest, AT&T studied other regions to identify strategic moves that could be used to secure the territory. On the West Coast, under the leadership of John Sabin, the Pacific Telephone Company had encountered little competition. In 1901 AT&T believed that entry had been forestalled in that area because the market had been widely developed through the use of inexpensive, ten-party service (ten customers sharing one connection to the central office).[31] In May 1901 AT&T put Sabin in charge of the Central Union Company. Upon taking control, he converted most of Central's customer connections from four-party to ten-party service. According to employees of Central and AT&T, this degradation in service increased the public's interest in obtaining service from the Independents, who mostly offered one- and two-party service.[32]

To the dismay of AT&T's chief engineer, Joseph Davis, and some other AT&T employees, ten-party service was unprofitable. Davis believed that the operating costs associated with ten-party service were so burdensome that the total cost of providing it was as high or higher than single-party service. But because of its inferior quality, the price for Bell's service had to be lower. Davis concluded that Central Union was providing service at a loss and advised the president of AT&T that the situation could only be reversed if Sabin was ordered to stop marketing ten-party service. Davis's proposal was rejected, and not until Sabin died in 1903 did the marketing of ten-party service terminate.[33]

The Independents' ability to take advantage of AT&T's strategic error was hindered by two factors. First, Central's below-cost prices made it difficult for the Independents to generate internal cash for expansion. Second, before service could be started in towns and cities, a franchise had to be obtained from the local government. The franchise often included regulations that were not part of the charter of Central Union or other Bell Operating Companies.

In granting a franchise to an entrant, the cities frequently stipulated maximum rates. The prices reflected the cost of doing business in an exchange that was comparable in size to the incumbent's. The low entry prices stimulated demand to an extent that had not been anticipated. Under the prevalent mode of manual switching, the cost per subscriber increased as the size of the network expanded. Larger networks

[30] Whitney, "Report," p. 5 (quote); and *Telephony*, 65 (Nov. 22, 1913), p. 23.

[31] Atwater, "History," pp. 53, 56, 68, 275. The Independents eventually did well on the West Coast because customers were attracted to their high-quality, one-party service. AT&TCA, Fish/Glass Mar. 23, 1903, PLB, vol. 27.

[32] Atwater, "History," pp. 78, 89, 275.

[33] Atwater, "History," pp. 53, 56, 68.

required more expensive switchboards, and operating procedures were more complex, requiring additional manual operations and time. Ironically, since the cost of service per subscriber increased as the number of telephones connected to the network increased, the entrants' success caused them to incur financial losses in some cities.[34] Although the Independents' initial prices were designed to cover their costs, the per-customer cost increased as their systems grew. Because the franchises did not include any mechanism for adjusting the price to reflect the increased cost, the Independents were in jeopardy.[35] But because the promise to sell service at low rates had influenced the granting of the franchise, the cities were reluctant to allow the Independents to raise their rates.

The degree to which city regulations hindered the Independents varied across the states. The Ohio Supreme Court decided in 1905 that the cities did not have the authority to fix rates, and therefore the Independents could adjust their rates to a paying basis.[36] The Indiana courts ruled differently, finding that the rates prescribed in the franchise were enforceable. This decision was especially harmful to the Indianapolis Telephone Company, which started service with rates approximately 50 percent lower than Central's during the monopoly era. The demand for the entrant's service exceeded the promoters' expectations, in part because the Independent also had a strong presence in the toll market. The New Long Distance Company connected Indianapolis subscribers with 48,000 customers in surrounding communities, whereas Central Union only offered access to 19,000 subscribers. The differential was a decided advantage for the Independent because the majority of toll calls were to neighboring communities.[37]

The Indianapolis Telephone Company found that in order to sustain good service, it needed to increase its exchange rates. Unlike Central Union, the Independent could not change its rates without permission from the City. In 1906, after extensive public hearings, the Board of Public Works turned down the request. According to one observer, city officials felt that because the Independent had proposed the original rates, it had to "make the best of a bad bargain."[38]

[34] See, for example, Lee, *Economics*, p. 74.

[35] The Independents' rates were not predatory because the below-cost prices were due to the regulatory process and were not adopted with the intent to drive an equally efficient rival out of business. Where left unconstrained by municipal regulations, the Independents raised their prices to reflect their increasing unit costs. WSHS, J. C. Harper to Wisconsin Railroad Commission, Sept. 1, 1907, series 1344, box 107, file 900.4.

[36] Stehman, *Financial History*, p. 88.

[37] New England Telephone, *Telephone*, pp. 61–63; AT&TCA, Richardson/Caldwell, Nov. 29, 1907, "Indianapolis," B1153; Sears, *Telephone Development*, p. 27; Pickernell/Fish, Oct. 20, 1905, reprinted in Federal Communications Commission Accounting Department, *AT&T Security Investments*, vol. 1, p. 129; and *Read et al*, "Testimony of Horace Hill," tr. 3037–38.

[38] AT&TCA, N.A., "Brief History of Indianapolis Litigation," "Indianapolis Consolidation," N.D., box 36.

As a result of the insufficient rates, the quality of service offered by Indianapolis Telephone declined.[39] This development coincided with improvements made in the Bell system. When Sabin died in May 1903, he was replaced by L. R. Richardson. Richardson found Central's service throughout the three Midwest states to be "poor." Central's general manager, Horace Hill, found, on the other hand, that the Independents' service was "satisfactory" and "efficient." Richardson decided that in order to win control of the territory, the quality of service on Bell's network had to be improved, and the number of cities connected to its network had to be increased. Advances in the quality of service were noticeable by 1905. Bell's principal advantage had been its superior long-distance connections, and Richardson felt that there was a need to establish a similar advantage in the short-distance toll market. Whereas the Independents had developed strong county systems, Richardson believed that the construction of cross-country toll lines would help improve Central's market position.[40]

While Richardson was upgrading the Central Union network, he took steps to retard the growth of the Independents. The decision of the Indianapolis Board of Works to deny its rate application damaged Indianapolis Telephone, but a more general problem for the Independents was Central Union's decision to operate at a loss until the Independents were driven from the market. Central Union could afford to improve and expand its network while operating at a loss because of the financial support provided by AT&T.

Theodore Vail, AT&T's President, commented that during the competitive era, Central Union stock was "practically valueless," and if not for AT&T's support, the firm would have been "liquidat[ed]."[41] AT&T invested approximately $30 million between 1898 and 1913, despite the prospect that Central would "have no earning capacity for a long-time." AT&T was willing to make these investments so that "the fight" in places such as Indianapolis, Toledo, and Columbus could "be carried out to a finish."[42] By curtailing or eliminating the profits of the Independents in their strongholds, AT&T was able to forestall their expansion into the monopoly markets of AT&T.[43] From the beginning of competition, a consensus had emerged within the parent organization and among the Bell Operating Companies "that the profit need not

[39] Stehman, *Financial History*, p. 86.

[40] AT&TCA, Richardson/Vail, Feb. 27, 1908, box 1357, (first quote); *Read et al.*, "Testimony of Horace Hill," tr. 3067 (second quote), tr. 3453–54; AT&TCA, Minutes of Board of Directors, Central Union, Mar. 18, 1908, p. 265; and Atwater, "History," p. 135.

[41] *Read et al.*, "Deposition of Theodore N. Vail," Feb. 1915, p. 241.

[42] *Read et al.*, American Telephone and Telegraph, "Brief and Argument for Appellant," Appellate Court of Illinois, First District, Gen. No. 23664, Mar. 1918, p. 2; and AT&TCA, Fish/Sabin, Dec. 24, 1902 (quote only) Private Presidential Letter Books [hereafter PPLB], vol. 2.

[43] *Read et al.*, "Final Decree by Judge William E. Dever," July 10, 1917, p. 77.

necessarily be immediately attached to the particular transaction, but that the company itself profit by what is done."[44]

Outside of Indianapolis, the Indiana Independents faced different constraints. In their smaller markets, city franchises were less of a limiting factor but prices were important. In Indianapolis, the Independent had a large share of the business market because the entrant had improved the quality of service. In other states, Independents had learned that if they continued to provide quality service, these high-margin customers would retain their service after a price increase. In less dense markets, where price was more of a factor, the Independents believed that it would be difficult to raise their rates unless Bell did the same. The Indiana Telephone Association suggested to Bell that the rivals end their ruinous rate wars. The Indiana Independents wanted to raise their rates to a paying basis, but believed that the rate increase would not be sustainable unless Central Union did the same. Central turned down the proposition and instead commented that competition in the industry "must and will" end.[45] AT&T was not willing to raise its prices to a paying basis until its rivals were eliminated.

Working with F. A. Pickernell, the AT&T official in charge of the parent company's competitive toll pricing policy, Central Union adopted other predatory tactics designed to limit the Independents' internal cash flow. Pickernell wrote to Richardson in 1905 that a means should be found to block the Indianapolis Independent from raising money for improvements: "If, by any means, the Indianapolis Telephone Company is prevented from getting money to put its plant in good condition, its earnings will decrease, and I would expect it would not be long before there would be difficulty in obtaining money to meet the fixed charges. This would mean . . . a receivership and a reorganization of the property."[46]

On March 2, 1909, partly in response to the deterioration of service on Indianapolis Telephone's network, the city of Indianapolis reversed its earlier position and granted the entrant a rate increase. Central Union, in line with Pickernell's suggestion, attempted to block this source of additional revenue by providing funding for a legal suit in opposition to the entrant's rate increase.[47] The Indianapolis suit was limited to the issue of the price for local service, because the city did not have the authority to regulate intercity (toll) rates. The outcome of litigation over

[44] AT&T, "Conference," p. 157.

[45] *Central Union News*, 3 (Feb. 1908), p. 8.

[46] *Read et al.*, Pickernell/Richardson, Oct., 13, 1905, reprinted in "Competition, Opposition, Mergers, Connection with Independents," p. 56 (quote); and AT&TCA, Fish/Caldwell, Dec. 1, 1905, PLB vol. 41.

[47] AT&TCA, N.A, "Brief History of Indianapolis Litigation," N.D.; and *Telephony*, 18 (Sept. 25, 1909), p. 317. Elsewhere, AT&T surreptitiously fought rate increases of the Independents in Court. See, for example, AT&TCA, Fish/Bethell, Dec. 23, 1902, PPLB vol. 2, and Fish/Yensen, June 26 and June 30, 1902, PLB, vol. 21.

local rates became immaterial when, on May 1, 1909, Central Union and AT&T reduced their rates on competitive toll lines. As described in the next section, this predatory rate reduction led to the sale of the Indianapolis exchange and other United States properties to an agent of AT&T.

CONTROL OF THE LONG-DISTANCE MARKET

In 1909 the Independents took an important step to overcome the dearth of long-distance trunk lines. They had already established regional networks in the Midwest, the Middle Atlantic States, upstate New York, and on the West Coast, and in the spring of 1909 the Independent Long Distance Telephone and Telegraph Syndicate took steps to unite the regional systems into a national network and increase the number of long-distance trunk lines. By mid-April the national toll company had either signed or was in the final stages of signing contracts with the nine regional Independent toll companies providing service east of the Rockies.[48]

This development concerned AT&T, for the regional toll companies had captured some of its traffic. At Buffalo, for example, the message growth rate on AT&T's monopoly toll routes was 26.5 percent for the three-year period ending March 1909, but only 9.6 percent on its competitive routes.[49] The growth of the Independents' toll network cut into Bell's profits as well as its traffic. Furthermore, Pickernell believed that the Independents' toll lines were often profitable, and their expansion was improving the position of the Independent exchange companies. He attributed the success of the regional Independent toll system in New York and elsewhere to four factors: the Independents had more customers in some exchanges, lower day rates, and offered both evening- and bulk-toll-rate discounts (neither of which were made available by AT&T). Pickernell believed that the cumulative effect of these advantages "ha[d] been considerable," as it had "rob[bed] the Bell system of a substantial amount of toll traffic, thus not only assisting the revenue of the opposition but greatly increasing its prestige with the more important telephone customers."[50]

Because of the threat the Independents posed to AT&T, Pickernell felt that AT&T "ought to do everything possible to hasten the downfall of the opposition in order that [their properties] may be purchased at a low price and merged with the Bell." AT&T had to do more than just match the rates of the Independents, for on heavily used routes, division of traffic at the Independents' rates would still be profitable for the

[48] AT&TCA, Contract United States Telephone with Max Koehler, Apr. 19, 1909, box 36; and *Telephony*, 19 (Mar. 26, 1910), p. 380.

[49] AT&TCA, Pickernell/Hall, May 21, 1909, B1376.

[50] Ibid.

Independents. Pickernell convinced AT&T officials to "attack" the Independents' most profitable lines, postulating that if the number of stations at two network nodes were essentially equal, the traffic would follow the rate.[51]

Pickernell advocated adopting rates that were lower than the Independents and that, if the Independent matched the price reduction, AT&T should "cut the rate again to a point that will control, or if [the Independent Toll Company] is losing money at least divide the traffic." AT&T's competitive toll-pricing policy architect argued that his plan would "enormously impair the earnings of the competitor with comparatively slight loss to the Bell company." The up to 50 percent price reductions would only be applied at competitive points. Pickernell thought that at the reduced rates, AT&T's earnings on competitive routes would be below the cost of money. He reckoned that because of AT&T's earnings in monopoly markets, there would be only a slight reduction in the firm's overall earnings. But the losses from a price war could push the opposition into receivership, and this would provide Bell with the opportunity to acquire its rivals and re-establish rates at the existing level.[52]

Pickernell's letters do not indicate the magnitude of the short-term loss that he thought might result from the price reduction. However, a letter written by B. Sunny, the president of the Bell Operating Company in Chicago, suggests that the forecasted annual loss to Central Union from a proposed rate cut that was being debated within AT&T in April 1909 may have been as little as $140,000. Sunny, in a letter to the president of AT&T, argued that losses at the Independents' strongholds in Ohio and Indiana were sensible because of the system-wide benefits to AT&T. By taking these losses, Central Union would prevent its rivals from operating profitably. If the existing Independents sustained losses, it would diminish their opportunity to expand into markets such as Chicago or to raise money internally for their toll lines. Naturally, a poor return on existing investments would also hurt the Independents' ability to raise money from external sources. Thus, Sunny wrote, the losses of Central Union were in the best interest of AT&T because they would help " 'exterminat[e]' " United States Telephone, a firm that was " 'a menance to our whole organization.' "[53]

In May 1909 Pickernell's policy was implemented. On competitive toll routes in the Central Union territory, as well as at other competitive points that were to be part of the Syndicate's emerging network, rates were cut by approximately one-third. The rate cuts were seen by the newspapers as an attempt to "checkmate" the Independents' national

[51] Ibid. (quote); and AT&TCA, Pickernell/Hall, May 12, 1909, B1376.

[52] Ibid.

[53] *Read et al.*, Sunny/Vail, Apr. 1, 1909, quoted in "Opinion Rendered by Judge William E. Dever," Jan. 20, 1917, pp. 135–36, and Testimony of Frank F. Fowle, tr. 633–35.

TABLE 2
IMPACT OF RATE REDUCTION IN 20 OHIO CITIES: TOLL MESSAGES AND REVENUES, SEPTEMBER 1908 AND SEPTEMBER 1909

	September 1908	September 1909	Percent Change
Messages			
Outward Central Union messages to reduced points	34,001	52,041	53.1
Outward Central Union messages to nonreduced points	26,766	29,783	11.3
Outward AT&T messages to reduced points	13,000	20,120	54.8
Outward AT&T messages to nonreduced points	5,196	6,650	28.0
Revenues ($)			
Central Union message revenue to reduced points	10,916	9,554	−12.5
Central Union message revenue to nonreduced points	5,271	5,628	6.8
AT&T message revenue to reduced points	9,662	9,152	−5.3
AT&T message revenue to nonreduced points	7,293	9,184	25.9

Source: AT&TCA, Thayer/Vail, Nov. 18, 1909, B2019, "Long Lines Department."

toll system.[54] When the price cuts were matched by United States Telephone, AT&T and Central Union cut their toll rates an additional third. The Independent did not match the second reduction because operations at that level would have meant doing business at a price that was less than the cost of business.[55]

Since AT&T's toll rates were now lower, United States Telephone could not continue in business. As Pickernell forecasted, traffic indeed followed the rate. The effect of the toll cut on Bell's traffic is shown in Table 2. Message volume increased by 54 percent on the short-haul routes of Central Union and the long-haul routes of AT&T. The rate reduction led to a short-term reduction in AT&T's profits. Despite the large increase in traffic, revenue declined.[56] In order to characterize an act as predatory, the aggressor must sacrifice short-term profits in order to increase long-term earnings. Because revenues declined, and AT&T's intent was to drive an efficient rival out of business, the price reduction was clearly predatory. Predation may also be inferred by looking at the price-cost relationship on competitive toll routes. Phillip Areeda and Donald Turner have argued that predation may be inferred

[54] *Daily Telephone News*, May, 4, 1909.

[55] *Telephony*, 18 (Aug., 21, 1909), p. 182, and 19 (Jan. 8, 1910), p. 53. United States Telephone did not indicate if the price was less than its average total or variable cost. The firm merely stated that operations were unprofitable at that level.

[56] The data also indicate the extent of toll competition. In 1908, 71 percent of the messages sent over AT&T's long-distance lines could have reached the same destination over the rivals' network. On short-distance toll calls, the option was only available for 56 percent of the traffic. The difference may be attributable to there being a lower likelihood of competition in small cities and towns. The long-haul traffic may have been between large cities.

TABLE 3
PRICE/COST RELATIONSHIP: AT&T'S COMPETITIVE LONG-DISTANCE TOLL ROUTES, SEPTEMBER 1908 AND SEPTEMBER 1909
(dollars)

	September 1908	September 1909
Revenue per message to reduced points[a]	0.743	0.455
Revenue per message to nonreduced points[a]	1.404	1.381
Nationwide average-variable cost per message	n.a.	0.48
Nationwide average-total cost per message[b]	n.a.	0.753

[a] Revenues are for messages originating in Ohio.
[b] Averages are calculated on the basis of variable cost plus depreciation and return on investment.
Note: n.a. = not available.
Source: AT&TCA, Thayer/Vail, Nov. 18, 1909, B2019, "Long Lines Department."

when prices are set below the average-variable cost.[57] Although region-specific cost data are unavailable, the available information suggests that AT&T's rates were below its variable cost of production. As shown in Table 3, the average revenue per message originating in Ohio was $0.455, $0.025 less than AT&T's nationwide average-variable cost per message.

Facing the prospect of future losses, United States agreed in October 1909 to sell its toll and exchange properties. In light of a recent circuit court's decision that found Standard Oil in violation of the Sherman Anti-Trust Act, AT&T was apprehensive that the Department of Justice might object to the acquisition of its former rival and therefore did not directly take over ownership of the properties.[58] Instead, it provided the R. L. Day Company with the funds for the purchase. The sale effectively put AT&T's market share at 100 percent in the territory formerly served by United States. After Day took over control of the Company, toll rates returned to their pre-May 1909 level.[59]

By adopting predatory prices, AT&T had succeeded in obtaining "key" properties at a fire-sale price. The United States's lines accounted for slightly over 50 percent of the regional Independent toll-line mileage. Day paid $7.3 million for the properties. AT&T's comptroller calculated that the value of the property was $12.85 million, a calculation based on both the earnings of the properties prior to the rate war, and the reproduction cost of the property. The two methodologies provided essentially the same result.[60]

[57] Areeda and Turner, "Predatory Pricing." Areeda and Turner's is but one of many tests for predation that exist in the law and economics literature. I have used their yardstick not because it is necessarily the most appropriate but because it is the most widely cited and one of the hardest to pass. For example, by comparison, Joskow and Klevorick have proposed a less stringent test that compares price with the average cost of production (Joskow and Klevorick, "Framework," p. 213).

[58] *Telephony*, 19 (Feb. 22, 1910), p. 186; and *Standard Oil v. United States*, 173 Fed. 177.

[59] *Telephony*, 19 (Mar. 26, 1910), p. 386.

[60] Sunny/Vail, Nov. 19, 1909 (quote), reprinted in Federal Communications Commission,

For a multimarket firm, the payoff from predation may extend beyond being able to buy out a rival at a low price. By establishing a reputation for predatory actions, the supplier is able to induce other rivals to take actions favorable to the incumbent. AT&T's toll-rate reduction in Ohio helped it secure control of St. Louis in the Fall of 1909. St. Louis was served by Bell of Missouri and the Kinloch Telephone Company. Kinloch had more toll connections to nearby points and consequently had higher per-station toll revenue. Financially, Kinloch was also more profitable. Pickernell estimated that, after proper allowance for depreciation, the entrant's return on actual dollars invested was 6.7 percent, 360 basis points more than Bell's rate of return. Kinloch's return was higher despite having effectively lower rate levels. The anomaly was the result of the entrant having lower maintenance and operator costs, as well as less spare capacity per subscriber.[61]

In 1908 Kinloch added 3,724 customers whereas Bell gained only 297 subscribers. AT&T felt that some action had to be taken in light of its rival's gains and the prospect that Kinloch would be able to expand further in the future. In August 1909 Bell replaced its measured service with Kinloch's flat-rate structure and levels. AT&T anticipated that because of increased expenses and the reduction in revenue, the change of rates would lead to a short-term financial loss of $250,000. Although AT&T executives expected that the revenue effect would be positive within a year, they did not believe that the new rates would provide a satisfactory rate of return in the long run.[62]

When Bell adopted the Kinloch rates, the entrant did not respond with a price reduction. Once the firm lost its status as the low-price supplier, however, its market share declined. Kinloch left its rates intact because it did not wish to enter "a vigorous rate war . . . similar to the Ohio campaign." Instead, despite its strong financial position, the firm exhibited an increased willingness to sell its properties to AT&T. The elimination of United States as a rival also increased the willingness of other Independents in such states as Ohio, Missouri, and Kansas to join the Bell network through a license contract.[63]

Ironically, the most serious legal challenge to AT&T's predatory actions was taken by some minority stockholders of Central Union, where AT&T was the majority stockholder.[64] Central's aggressive

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Control, vol. 3, p. 174; and AT&TCA, DuBois/Vail, Oct. 12, 1909, "Ohio Consolidation," box 36. Burns, "Predatory Pricing," has provided an econometric estimation of the impact predation had on the prices of tobacco manufacturers acquired by American Tobacco. I am unable to employ Burns's methodology because of the lack of financial data for the overwhelming majority of firms acquired by AT&T.

[61] AT&TCA, Thayer/Durant, Feb. 24, 1909, and Pickernell/Thayer, June 2, 1909, box 4.

[62] Ibid.; and AT&TCA, Pickernell/Thayer, June 7, 1909, box 4.

[63] AT&TCA. Calhoun/Brooke, Jan. 18, 1910 (quote), and Transcript of Conversation between Calhoun and Brooks/Wilson, Mar. 23, 1910, box 4; and *Telephony*, 19 (Mar. 26, 1910), p. 377.

[64] Federal and State agencies considered blocking the sale of U.S. Telephone properties, but no

response to entry was in the best interest of AT&T, but the reverse was true for its minority stockholders. During the competitive era Central operated at a loss, paid no dividends, and the stock sold below par. In *Read et al. v. Central Union*, the judge found that the decision of Central Union to respond aggressively to entry, rather than act as a cooperative duopolist, hurt the minority stockholders of Central Union. The jurist noted that Central Union had "borne the full burden of this expensive fight." The decision of Central Union's directors to adopt policies that were in the interest of AT&T rather than that of the firm was a violation of their fiduciary responsibilities. For this reason, along with other fiduciary violations and AT&T's attempt to monopolize the telephone market, the judge ordered AT&T to sell its holdings in Central Union. The sale did not occur, because prior to the end of the appeals process, an out-of-court settlement was reached between the firm and the plaintiffs. AT&T agreed to pay the minority stockholders $1.75 million for 1,978.5 shares. The stock had a par value of $197,850 and a market value of approximately $90,000.[65]

THE INDEPENDENTS' FAILED EFFORT TO ENTER AT&T's MONOPOLY MARKETS

Regulatory Barriers to Entry

When the Indianapolis Telephone Company obtained its franchise, it did not anticipate how the setting of its local rates by the city would harm its long-term prospects. The Indianapolis maximum-rate rules were but one of many seemingly innocuous state and local rules that severely damaged the Independents. In this section, I explain how

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action was taken. In December 1909, in anticipation of legal action, R. L. Day Company informed AT&T that it no longer wanted to hold the properties. Upon hearing this news, AT&T asked J. P. Morgan & Co. to take control of the properties. AT&T informed Morgan that a transaction had to occur quickly, and therefore the investment firm abandoned its standard procedure of determining the value of the properties. Morgan/Vail, Aug. 9, 1915, reprinted in Federal Communications Commission, *Report*, vol. 3, appendix 16, p. 24. The antitrust authorities apparently dropped the investigation after an officer from Morgan submitted a sworn affidavit stating that the purchase had been made " 'as an investment . . . with its own moneys,' " and that there was no agreement with AT&T regarding the control or management of United States Telephone, nor an arrangement to lessen the extent of competition. *Telephony*, 9 (Jan. 22, 1910), p. 88, and 55 (July 16, 1910), p. 57.

[65] *Read et al.*, "Final Decree by Judge William E. Dever," July 10, 1917; and Read/Kinsgsbury, Apr. 4, 1919, reprinted in Federal Communications Commission, *AT&T Security Investments*, vol. 1, appendix 9, p. 16. A similar suit was almost filed in New York. AT&T had feared that an Independent stronghold in upstate New York would serve as a lever for gaining entry into New York City. The upstate Bell Operating Companies operated at a loss in order to protect AT&T's profitable New York City monopoly. Because of these predatory losses, the minority stockholders of the upstate New York Bell Operating Companies threatened to sue AT&T for violating its fiduciary responsibilities. The suit was not filed because AT&T provided satisfactory compensation when these upstate companies were merged with the profitable downstate firms. AT&TCA, Vail/Gould, Apr. 3, 1908, PPLB, vol. 6.

regulatory barriers to entry impeded the Independents' ability to expand into AT&T's most profitable markets.

The Independents had to establish exchanges in New York, Chicago, and other monopoly markets of the incumbent in order to counter Bell's expansion, improved service, and predatory actions.[66] AT&T's expansion had been funded in part with borrowed money, and a substantial portion of this capital was invested in areas where the Independents were strong. Because of this competition, the investment "[did] not bring back proper return."[67] If AT&T's monopoly exchanges lost their ability to cover these losses, the firm would have had difficulty repaying its loans. As aptly noted by a New York City official, the high returns in monopoly exchanges "seem[ed] to invite competition."[68] In 1905 the Independents were busily trying to enter the large cities in which AT&T still held monopolies. Entry conditions were ripe. There was strong public interest in the establishment of Independent exchanges, and because AT&T's resources were strained, the firm would have found it difficult to respond aggressively toward new rivals.[69] In some cities franchise procurement was dependent on the outcome of a public referendum. In 1906 and 1907 referendums were held in Denver, Omaha, Portland (Oregon), and San Francisco, and an overwhelming majority of people voted to grant the Independents franchises. In New York City, there was widespread dissatisfaction with Bell's prices and rate structure. Chicago residents also expressed keen support for the Independents because of the toll connections that would become available to those markets the Independents controlled.[70]

Entry into AT&T's monopoly markets was, however, impeded by state and local regulations. Municipal officials were aware of Bell's large earnings during the patent period. This, along with the heated bidding between promoters, made it clear that a telephone franchise was a highly valued, intangible property. City officials in the early twentieth century, unlike those in the 1870s, were not going to give this right away without imposing conditions. When franchises were issued to the Independents, therefore, they typically included stipulations that set maximum rates, required free telephone service to the city government, free use of the telephone poles and underground conduits for fire and

[66] WSHS, "To the Citizens of Madison: Statement Issued by Dane County Telephone," 1906; and Whitney, "Report," p. 32.

[67] AT&TCA, Fish/Pickernell, Aug. 3, 1906, PPLB, vol. 5 (quote); and Garnet, *Telephone Enterprise*, p. 192, fn.11.

[68] Nichols, "Report," p. 22 (quote).

[69] Garnet, *Telephone Enterprise*, p. 127.

[70] *Western Electrician*, July 1, 1905, p. 11, and Mar. 3, 1906, p. 184; AT&TCA, Fish/Burt, July 29, 1905, PLB, vol. 40; *Telephony*, Dec. 1906, p. 358; Weik, "Telephone Movement," pp. 267–68; *City Record*, June 25, 1907, p. 1; *Daily Telephone News* (1905 issues); and Richardson/Fish, Oct. 16, 1901, reproduced in Atwater, "History," p. 76.

police lines, and royalty fees.[71] These regulations constituted a barrier to new entry because they were not imposed on Bell as well. Many of Bell's franchises had been granted when telephony was new and its commercial value uncertain. They therefore did not include similar requirements.

The establishment of these barriers owed to a mixture of three factors. First, as just described, cities were seeking to share the profits from the rapidly growing service. Second, as I will show, laws and franchises were granted that had unanticipated deleterious effects on entrants. Finally, Bell successfully lobbied (at times illegally) for municipal rules that were harmful to entrants.[72]

The Independents considered New York City the "keystone" of the Bell System, as Manhattan alone accounted for approximately one-fifth of all Bell Operating Company profits in 1903. Such a lucrative market invited repeated but unsuccessful Independent challenges to AT&T's monopoly position.[73] New York Electric Lines, for instance, failed to gain entry because a state court ruled that the city was required by contract to compel joint use of the conduit owned by the Empire Subway Company, a subsidiary of AT&T. An 1884 state law had required the placement of utility wires underground. At that time, underground transmission was experimental, and therefore it was difficult to raise capital for the construction of the conduits. Empire Subway had agreed to build the subways on the condition that New York City require other utilities to use their conduit. Empire agreed to make space open to others when it was available and to rent the space at a "reasonable rate." No procedure was established to determine what constituted a reasonable rate.[74] Neither New York Electric Lines, nor any other entrant, wanted to rely on Empire for subway space. When the potential entrants did attempt to rent space, they were usually told it was unavailable. When Empire made space available, the rates appeared to be unreasonably high.[75] Despite these unfavorable entry conditions, the court's ruling left the Independents with no alternative.

The last major Independent effort to enter New York City was made by the Atlantic Telephone Company in 1907. The Board of Estimate and

[71] See, for example, AT&TCA, "Ordinance Granting Telephone Franchise to Automatic Telephone Company by Board of Public Works," New Bedford, June 27, 1899.

[72] Hendrick, *Age*, p. 123. For example, Louis Glass, Vice-President of Bell's Pacific Telephone Company, was convicted of giving bribes to the City of San Francisco supervisors in exchange for their refusal to grant a franchise to an Independent. *Telephone Securities Weekly*, Sept. 7, 1907, p. 3.

[73] Latzke, *Fight*, p. 12 (quote); and AT&TCA, Hall/Fish, July 24, 1904, box 1348.

[74] *People ex. rel. New York Electric Lines Co. v. Ellison*, 81 Northeastern Reporter 447, 449 (1907); New York Laws of 1884, chap. 534; New York Laws of 1885, chap. 499; and AT&TCA, Merchants' Association of New York, "Inquiry Into Telephone Service and Rates in New York City" (1905), p. 15, box 1019.

[75] *New York Tribune*, Mar. 15, 1905; and Federal Communications Commission, *Report*, vol. 3, appendix 14.

Apportionment granted Atlantic a franchise in June, but conditions included in the franchise prevented the company from beginning construction. Like New York Electric Lines, Atlantic had to rent conduit space from Empire. In addition, it had to pay an initial $250,000 licensing fee and had to obtain the permission of the Board of Alderman in order to issue stocks or bonds. Bell was not subject to either of these requirements.[76] The fee was included in the franchise because the city believed that the license had an "inestimable value" to the Independents and that the local government should get a share of the gains. The regulation of stocks and bonds was made part of the franchise because of the city's belief that "[n]early all the complaints against public service corporations [were] traceable to over-capitalization."[77]

A fourth clause included in Atlantic's franchise contract best illustrates the kind of difficulties encountered by entrants to the New York City market. After receiving the franchise, Atlantic had only six months to show city officials contracts that established toll connections to all cities with populations greater than 4,000 people within a 1,000 mile radius. Failure to meet this, or any other condition, was grounds for charter revocation. This toll-connection stipulation required Atlantic to offer its subscribers the same ubiquitous service available on the Bell network. Although supplying this level of service was certainly an objective of the Independent movement, in the short-term it was virtually impossible to achieve. Individually and collectively, regulatory barriers to entry increased the risk of constructing an Independent exchange in New York. Since the franchise requirement of toll connections to cities within a 1,000 mile radius could not be met, potential investors faced the threat that the Independents' New York franchises would be revoked.

Nearby Connecticut passed a law in 1899 that essentially established an unregulated telephone monopoly. At that time, the legislature was considering a request from the Independents for a corporate charter to do business in the state. Extensive hearings in which the Independents and Bell argued over the merits of rival networks led only to a stalemate. Finally, the Independents and Bell agreed that the substantive issue of opening up the market should be considered by some other party than the legislature. With the support of both parties, the legislature passed a law requiring an entrant to obtain a special charter from the Connecticut legislature, as well as a superior state court finding that competition was justified by public necessity. Eight years later, when it was apparent that the 1899 law was a barrier to entry, the Independents claimed that neither they nor the legislature had understood that the law would stifle competition. Although a 1907 amendment to the law removed the

[76] *City Record*, June 25, 1907, pp. 3–4; and *Telephone Securities Weekly*, June 29, 1907. Eight months later, the city agreed to modify the license fee. ibid., Feb. 22, 1908, p. 5.

[77] *City Record*, May 1, 1906, pp. 3–5.

requirement of a state charter, the need to obtain a court finding was still a significant impediment to entry.[78] For example, investors believed that the law raised their level of risk, and as a result, they were reluctant to provide any financing until this barrier was removed.[79] Moreover, the procedure forced entrants to reveal information that Bell could use to improve its operations while the court was considering their petitions.

The Connecticut law was but one of many regulatory barriers that prevented the Independents from constructing a ubiquitous network. A combination of municipal and court rulings blocked the Independents' efforts to establish exchanges in Boston and Chicago. The Board of Alderman of Boston granted an Independent the right to install telephone lines on specific streets in 1906, but construction could not begin until the legality of the permit was validated. In 1909, the Massachusetts State Supreme Court ruled that the grant was unconstitutionally vague because "[n]o specific part of any street [was] designated."[80] In 1907, the Chicago City council rejected an Independent firm's petition to construct an exchange. The Council found that the proposed rates were unreasonably low and therefore concluded that the petition was not credible.[81]

Capital Markets

AT&T's aggressive response to the Independents impaired the entrants' ability to raise capital internally. Funds were needed for entering new markets and for expanding the size of existing facilities. Lacking sufficient internally generated funds, the Independents attempted to raise money from the nation's capital markets. Their effort was impeded, however, by their poor earnings records, by franchise requirements, and by capital market imperfections.

The Independents spent considerable effort trying to raise capital in New York. Their securities were not traded on the New York market and they believed that one reason for this was that they had had less direct contact with the East.[82] Although there were many financial magazines and newspapers during this period, little coverage was given to the Independents. Nor were there any major security-rating services that could help investors evaluate the financial standing of the Independents. Moody's, for example, did not directly rate the soundness of different securities but merely suggested that investors learn from the habits of more sophisticated buyers. *Moody's Classified Investments* advised that an investor could infer that a security was relatively safe if

[78] Laws of Connecticut 1899, chap. 158, and 1907, chap. 245; Connecticut Legislature, *Connecticut Judiciary Hearings* (1905), pp. 616–17, and (1907), pp. 16, 149–55, 763–64.

[79] *Commercial and Financial Chronicle*, 69 (Dec. 16, 1899), p. 1223.

[80] *Metropolitan Home Telephone Company v. Emerson*, 202 Mass. 402, 403 (1909).

[81] *Telephone Securities Weekly*, Jan. 11, 1908, p. 3.

[82] Weik, "Telephone Movement," pp. 267–68.

leading banks and financial institutions included the item in their portfolios. The investment manual presented a list of the securities held by large institutions. Unlike Bell's, the Independents' securities were not widely held by the large financial institutions in the East.[83] Based on the information found in Moody's, an investor could conclude that Independent securities were relatively risky as compared to Bell's. If risk-averse small- and medium-sized investors relied on Moody's investment method, the Independents would need to convince large financial institutions to invest in their securities before small investors would be willing to invest in their companies.

The large investors, however, were closely allied in their support of AT&T. Firms such as J. P. Morgan and Kidder Peabody sought to establish industrial order. This translated into providing financing for only one firm—AT&T. To do otherwise would have promoted competition. These underwriters were closely tied with other large financiers, and they used these connections to deny the Independents access to funds.[84] For example, in 1902, George Sheldon, a member of the New York Stock Exchange, decided to help provide the financing for an Independent company in Milwaukee. When the president of AT&T learned of this, he asked an official of J. P. Morgan & Co. to talk to Sheldon about withdrawing his support. Sheldon was subsequently visited by George F. Baker of the First National Bank and George W. Perkins of J. P. Morgan and Co. According to Sheldon, Baker and Perkins convinced him that he "could not be in the position of actively pushing an opposition to their interests in Milwaukee." He withdrew his support. After Sheldon dropped out, the Independents' effort to establish an exchange in Milwaukee collapsed.[85]

AT&T's President Fish frequently relied on business associations in the financial community, industry, and other public utilities to interfere with the Independents' expansion plans.[86] Particularly threatening to AT&T was the possibility that the Independents would rent space on telegraph-company poles, a move that would have reduced the cost of establishing a toll network. Western Union and Postal Telegraph agreed not to rent the Independents space; in exchange, AT&T promised that it would not let one telegraph company use AT&T's facilities for the

[83] *Moody's Classified Investments*, pp. 7–8.

[84] *Read et al.*, "Testimony of Leroy Kellogg," tr. 8464, 8519; Moody, *Masters*, pp. 117–18; Keller, *Life Insurance Enterprise*; Redlich, *Molding*, vol. 2, pp. 379–80; and Carosso, *Morgans*.

[85] AT&T compensated Sheldon for the expenses he had incurred in support of the Independents. AT&TCA, Fish/Steele, June 19, 1902, PPLB, vol. 1, Fish/Sheldon, Jan. 23, 1903, PLB, vol. 26, and Sheldon/Fish, July 30, 1902 (quote), box 66.

[86] See, for example, AT&TCA, Fish/Burt, Aug. 19, 1905, PLB, vol. 40, Fish/Waterbury, Oct. 4, 1902, PPLB, vol. 1, and Fish/Thayer, Apr. 18, 1902, PLB, vol. 20.

purpose of getting into territory controlled by another telegraph company.[87]

The incumbent also used strategic acquisitions to impede entrants' access to capital. AT&T was aware that in large cities telephone manufacturers would install equipment for the Independents in exchange for their stocks and bonds. In part to end this source of financing, AT&T purchased two of the leading Independent manufacturers, Stromberg-Carlson and Kellogg Manufacturing. AT&T controlled Kellogg from 1902 to 1909, when the holding was found to be a restraint of trade, and AT&T was ordered to sell the properties.[88]

Unable to raise money in the East, the Independents had to rely on regional stock exchanges in Cincinnati, Columbus, St. Louis, Toledo, Minneapolis, and Cleveland. These exchanges, however, were inadequate for the task. For example, Cleveland was one of the largest regional stock exchanges, but in 1906 the number of shares traded there was less than 1 percent of the volume traded on the New York Stock Exchange.[89] It was not feasible for these smaller markets to handle the large capital requirements of a telephone network.

Regardless of whether the market was in the East or the Midwest, investors were aware that AT&T had a major institutional advantage over its competitor. A critical criterion used by "conservative bankers" to evaluate the financial soundness of a public utility was to measure how its franchise compared with that of its rival.[90] Since the Independents' franchises often included regulations that were not part of the Bell Operating Companies' permits, the Independents' securities were a more risky investment.

THE POSTCOMPETITIVE YEARS

According to McGee, even if a dominant firm engages in predation, society's welfare may increase. Customers benefit from low prices, and these gains may exceed the losses that occur if the predator gains monopoly power.[91] AT&T's below-cost pricing did provide some short-run benefits, boosting the number of subscribers on AT&T's network as new customers were attracted by the low prices. But this rapid development ended with the disappearance of the Independents. As shown in Table 4, telephone growth was at its peak during the competitive era. With the demise of the Independents, AT&T's commercial department no longer had the same incentive to seek new

[87] AT&TCA, Fish/Chandler, Feb. 13, 1907, PLB, vol. 47, and Fish/Clowry, Jan. 31, 1905, PLB, vol. 37.

[88] *Dunbar v. American Telephone and Telegraph*, 238 Illinois 456, 478–81 (1909).

[89] *Journal of Commerce and Commercial Bulletin*, Jan. 3, 1907; and *Finance*, Feb. 9, 1907.

[90] Vanderlip Collection, Frank A. Vanderlip, "Address to National Electric Light Association," June 1909, box D-13.

[91] McGee, "Predatory Pricing," p. 168.

TABLE 4
TELEPHONES PER 1,000 POPULATION: RATES OF GROWTH, 1885–1929

Years	Percent Growth
1885–1893	4.6
1894–1907	20.6
1908–1912	5.5
1913–1917	3.9
1918–1929	3.1

Source: U.S. Department of Commerce, *Historical Statistics*, vol. 2, p. 783.

customers. The slow rate of development during the post-competition years occurred despite a low level of telephone penetration—in 1920 only 35 percent of the households in the United States had telephones.

During the competitive era, AT&T for the first time took a keen interest in developing the rural market. The incumbent realized that the areas outside the cities had to be secured, otherwise the Independents would use their stronghold to gain entry into AT&T's profitable urban markets. But the passing of competition reduced Bell's incentive to develop the rural market. Consequently, the proportion as well as the number of farms with telephones declined in the 1920s and 1930s.[92]

Finally, as result of the lack of competition and effective regulation, AT&T's long-distance operations earned an average annual rate of return of 10.9 percent between 1913 and 1935. The firm's cost of money during these years was approximately 5 to 6 percent.[93] The sizeable difference between the cost of money, and AT&T's earnings on toll calls suggests that there was a significant, persistent welfare loss to society due to the elimination of competition.

CONCLUSION

Recent research in business history has emphasized that AT&T emerged as the industry leader because of the firm's strategy and structure. Researchers have concluded that AT&T's decision to build and control centrally a higher-quality network than its rivals was the primary factor that determined the incumbent's success. The evidence presented in this article suggests that for the first decade of competition in the Midwest, AT&T marketed an inferior local service, had a smaller toll network for the area in which most toll calls were placed, and maintained its operations poorly. Furthermore, AT&T's operations were unprofitable. Despite these liabilities, by 1910 the firm emerged in control of the region. The vanquishing of the Independents' challenge

[92] Fischer argues that falling farm prices only partly account for the decline. The decrease in telephone subscription coincided with an increase in the percentage of farms with automobiles, indoor water and electricity, and radios. Fischer, "Technology's Retreat," pp. 295–97, 315.

[93] Federal Communications Commission, *Long Lines*, p. 15, and *Investigation*, p. 435.

owed to important strategic moves by AT&T's management, not least of which was predatory pricing.

McGee has pointed out that in the absence of barriers to entry, it would be "foolish" for a firm to engage in predatory price cutting. Without this protection, the predator cannot be certain that even if it regains control of the market, it will be able to recover the losses sustained during the price-cutting period.[94] Although there were no legal barriers to entry for the provision of toll service, AT&T was able to prey on its rivals because of other obstacles in local markets. State and municipal regulations, and to a lesser extent AT&T's ties with the nation's leading financiers, established barriers that allowed the game of rivalry to be played sequentially, rather than simultaneously.[95] If competition had occurred simultaneously in all markets, AT&T would have been unable to adopt a predatory strategy. As it was, by operating at a loss at competitive points, AT&T hindered the Independents' ability to raise capital for the construction of an integrated network. The shortage of money also undermined what was originally the Independents' strongest competitive asset—their quality of service. Lacking the internal cash flow needed for the proper maintenance of their facilities, they had to watch the quality of service on their networks deteriorate.[96] The financial panic of 1907 exacerbated their financial problems. Consequently, AT&T reemerged in control of the industry as increased numbers of Independents either sold their properties to Bell or joined Bell's network on terms that had been considered unsatisfactory a few years earlier.

The historical analysis presented here provides some insight into the contemporary analog of the *Standard Oil* case, the court-approved divestiture of AT&T in *United States vs. AT&T*.[97] In 1974 the Justice Department charged AT&T with conduct that had been "designed to maintain and expand its existing telecommunications service monopoly."[98] Section 2 of the Sherman Anti-Trust Act prohibits attempts to monopolize an industry. Justice Department lawyers argued that during the post–World War II era, AT&T violated this law by preying on rivals. According to the Department of Justice, AT&T was able to impede competition through its control of local exchange facilities: "Local telephone exchanges are 'bottlenecks' under classic antitrust theory. The control of these franchises provides AT&T with the incentive and opportunity to protect, maintain and extend its monopoly in telecom-

[94] McGee, "Predatory Pricing," pp. 142, 168 (quote).

[95] In a review of federal antitrust cases that led to convictions, Koller found a high correlation between predatory attempts and facilitating government practices. Koller, "Myth," p. 113.

[96] AT&TCA, Allen/Fish, Nov. 6, 1902, Dec. 3, 1903, and Jan. 8, 1904, ALB.

[97] *United States v. AT&T*, 552 F. Supp. 131, 226–34 (D.D.C. 1982), *aff'd, Maryland v. United States*, 460 U.S. 1001 (1983).

[98] U.S. Department of Justice, Plaintiff's First Statement of Contentions and Proofs, *United States v. AT&T*, 74-1698 (D.D.C), p. 4.

munications services overall." In order to eliminate this structural impediment to competition in the long-distance, telecommunications-equipment, and information-service markets, the government proposed that the Bell Operating Companies be prohibited from providing these services.[99]

AT&T replied that it was not guilty of any Section 2 violations, and that divestiture of the Bell System would not be in the nation's best interest, because AT&T had "provided . . . the world's best telecommunications service." AT&T argued that the monopoly structure was the result of "technological and economic imperatives" in the industry. "A review of the history of the telecommunications (from 1876 to [the] present) makes it plain that the structure of the industry . . . evolved directly from the technological imperatives of networking, the interactive and interdependent nature of the telecommunications network, and the need for a single network manager to control, plan and operate the network in order to assure efficiency."[100] By contrast, the review of AT&T's conduct from 1894 to 1910 presented in this article suggests that the monopoly structure of the telephone market was not merely the result of "technological and economic imperatives," but also resulted from such Section 2 violations as predatory pricing, funding of court cases in order to interfere with price increases granted to the Independents by municipalities, acquisition of manufacturers of telephone equipment in order to limit the Independents' access to the capital markets, and bribes or threats to financiers to discourage financing of the Independents.[101]

Until the market for exchange facilities becomes competitive, the possibility that exchange companies will prey on competitors in order to forestall entry into the telecommunications industry remains very live.[102] By separating the ownership of long-distance and local facilities, the Department of Justice in *United States vs. AT&T* succeeded in eliminating the incentive for local exchange companies to thwart their rivals' efforts in the long-distance market. Although this structural separation increased the degree of competition in the interexchange market, it did not eliminate the threat that local exchange companies may attempt to leverage their control of the telephone market into new data and video markets. In most areas today, the telephone line provides the only available means of two-way communications. Until economical, alternative avenues of electronic communication become

[99] Ibid., pp. 4 (first quote), 70 (second quote), 527.

[100] Defendants' First Statement of Contentions and Proof, *United States v. AT&T*, 74-1698 (D.D.C.), pp. 1 (first and second quotes), 4, 80 (third quote).

[101] Abuse of the regulatory process with the intent to harm competitors is evidence of unlawful intent and purpose to monopolize. *Otter Tail Power Co. v. United States* 410 U.S. 366, 379–80 (1973), *on remand*, 360 F Supp. 451, 451–52 (D.Minn. 1973).

[102] *United States v. Western Electric*, 673 F. Supp. 525, 540–62 (D.D.C. 1987).

more widely available, regulatory authorities should continue to exercise due diligence over the practices of local exchange carriers.

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The early life of Guglielmo Marconi 1874-1895

Guglielmo Marconi (1874-1937) was born in Bologna, Italy and has been called the 'father of radio'. In the early 1890s, Marconi began reading papers on the topic of 'Hertzian waves', including those by, amongst others, James Clerk Maxwell, Heinrich Hertz, Nikola Tesla and Sir Oliver Lodge. These individuals had performed important research on electromagnetism, and had indeed quantified the underlying theories; they had also introduced a number of important experiments that demonstrated the principles involved. However, it can be said that Marconi was the first individual to both consider and realise the practical and commercial application of this technology; he took 'wireless telegraphy' out of the physics laboratory and into the industrial world. In 1894 Marconi began performing experiments with wireless telegraphy, mentored by Professor Augutus Righi, a close family friend, expert on 'Hertzian waves' and professor at the University of Bologna. Marconi used so-called 'Righi oscillators (improved multiple oscillators) in his early wireless telegraphy experiments. Marconi soon succeeded in signalling up to a distance of 1.5 miles using basic and crude apparatus. Marconi immediately appreciated the military potential of such a signalling system and offered the technology to the Italian government who refused.

The early history of the Marconi Company 1896-1914

The history of the commercial development of wireless telegraphy has its origins in England: in March 1896, Guglielmo Marconi lodged the first wireless telegraphy patent: a 'holding patent' for a wireless telegraphy system in London. On 2 June 1896, Marconi lodged a full specification for the world's first practical wireless telegraphy system and by the end of

the year had extended the range of communications to nine miles. In July of 1897, Marconi was granted his famous British patent (No. 12039) and founded the Wireless Telegraphy and Signal Company Ltd. in London, with the intention of acquiring Marconi patents on an international scale. In December 1897, Marconi established the first wireless station, at the Royal Needles Hotel on the Isle of Wight. It has been said that "from 1897 until the cataclysm of World War One, Wireless Telegraphy was woven into the social and economic fabric of the most sophisticated societies with astonishing speed."

In December 1898, the Marconi Company opened the world's first wireless factory at Chelmsford, Essex. On 27 March 1899, Marconi transmitted across the English Channel from Wimereux near Boulogne, France to South Foreland Lighthouse near Dover, England. Also in 1899, wireless telegraphy was adopted by the British Royal and Merchant Navies. On 12 December 1901, a wireless signal consisting of the Morse code for the letter 'S' was successfully transmitted across the Atlantic from Poldhu, Cornwall to Signal Hill, St John's, Newfoundland, Canada. This transmission over a distance of nearly 2,000 miles was a major achievement as even Marconi himself was unsure of the maximum range of this new technology. By the end of 1902, Marconi had established permanent and reliable wireless stations at Glace Bay in Nova Scotia, Canada and Cape Cod, US. By 1903, the Company had built a number of stations on shore and many merchant ships had been fitted with its wireless sets, which had to be rented from the company and were operated by Marconi personnel, who were allowed to communicate with operators using apparatus from rival companies during emergencies only. As a result of the growing maritime business the Marconi Company began to make a profit.

By 1904, wireless telegraphy had succeeded in being widely recognised as an essential means of modern communication and was used by both side in the Russo-Japanese War of that year. In January 1909, wireless telegraphy saved over 4,000 lives when it was used to call for rescue when the SS Republic collided with

the SS Florida off the shores of Nantucket; this provided the Marconi Company, and indeed wireless telegraphy itself, with the respectability and public acclaim it had been clamouring for. Later in the year, Marconi was co-awarded the Nobel Prize for Physics; the prize was shared with Prof. Karl Ferdinand Braun, a fellow pioneer in the field of wireless telegraphy.

In March 1910, the Marconi Company put forward a plan to link the many far-flung parts of the British Empire by a world-wide chain of 18 high power wireless stations including shore-based and ship-based stations, charging half the cost of cable telegraph rates. It was suggested that this 'Imperial Wireless Scheme' would be of great strategic advantage, providing ships of the Royal Navy with a global means of communication unhampered by vulnerable landlines and submarine cables. However, the British government was reluctant to hand the communications network of their empire to a commercial monopoly and so negotiations began. Meanwhile, Marconi wireless telegraphy received a major publicity boost when it was used to aid the capture of a criminal. In July 1910, the infamous Dr Crippen murdered his wife in England and then fled to Canada with his new lover. The pair appeared suspicious to the captain of their ship, who then sent a wireless message to Scotland Yard, and hence they were arrested when they arrived in Canada. This was the first recorded instance of wireless telegraphy being used to aid police work.

By March 1912, the negotiations for the Imperial Wireless Scheme had just been completed when a scandal emerged. While there are many different versions of what actually occurred, it was suggested at the time that the Marconi Company won the contract because of government corruption (i.e. politicians and civil servants were bribed with Marconi shares) and also had conspired to rig the price of these shares on the stock market. However, all of this would be sidelined by the Titanic disaster on 14 April. The details are well known and the event itself has remained in public consciousness ever since that fateful night in 1912. Thanks to wireless telegraphy,

712 people were saved. While the public was awestruck and captivated by the wonders of this new invention of wireless telegraphy, the deaths of 1,517 people shocked the maritime authorities. An investigation into the tragedy concluded that while wireless telegraphy was an invaluable means of saving lives at sea, the overall system and method of usage could be much improved. These improvements were agreed upon at an International Conference on Safety at Sea in London. On 20 January 1914, 16 nations agreed on 74 Articles for improved safety in shipping, including the usage of wireless telegraphy.

By the time the 'Marconi Scandal' had reached its conclusion in 1914, the Marconi Company suffered massive losses in terms of finances, pride and public confidence, along with the loss of the Imperial Wireless Scheme contract. However, "from all this political turmoil the Marconi Company, as a Company, emerged with colours tattered but still flying." It was a weakened but still formidable Marconi Company that would await the perils and successes of World War One in August 1914.

The Marconi Company 1918-1940s

In 1914, Marconi joined the Italian Army but later transferred to the Navy where he investigated the use of short wave transmission. In 1920, the Marconi Company was an early pioneer in Britain in the new field of public broadcast radio, thereafter Marconi and his company went on to great success in the post-war years. Marconi died in Rome on 20 July 1937.

- Elizabeth Bruton

Chapter 2 – Wireless

This section is about the invention and evolution of the wireless industry prior to the birth of radio broadcasting in the 1920s. The idea of communications through the "ether" without wires was mysterious and exciting. Guglielmo Marconi made the scientific experiments practical and established wireless telegraphy as a business. Technological progress was rapid, with multiple inventors and entrepreneurs contributing technologies that expanded usefulness from coastal ship-to-shore applications to transoceanic distances and locations where wires could not reach. The British Marconi Company[1] was the industry leader by (like AT&T) refusing to allow ships with its equipment to communicate with ships that used wireless sets sold by other companies. By WW I, General Electric and Westinghouse had developed or bought rights to improved technologies and were selling equipment to compete with Marconi. Wireless was telegraphy, but the vacuum tube made possible wireless transmission of voice. Apart from a few experiments, voice transmission was perceived to be a point-to-point application useful mainly for field operations or locations where telephone wires were not feasible. AT&T thought about using wireless voice to span the US when long distance wire transmission was difficult, but found it not to be useful in the telephone business. When WW I started, the importance of wireless for war efforts was quickly recognized and the government took over all US wireless activities. Wireless technology had developed dramatically, but its future in broadcasting was not perceived.

Tuning, directionality, primary

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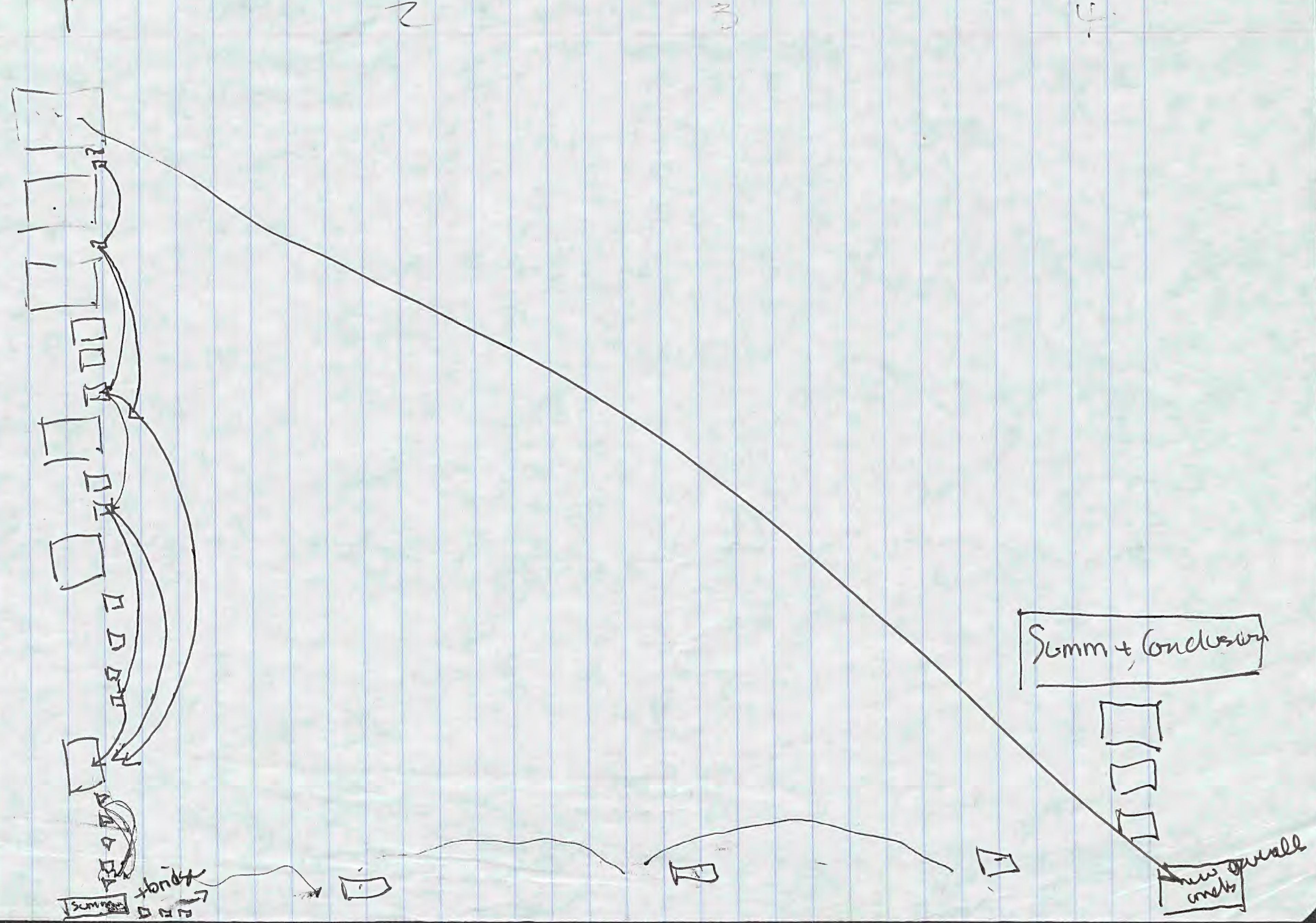
1 As with Bell and AT&T, we need to adopt a simplified naming convention.

2 Impressed by Marconi's wireless coverage of the Kingstown Regatta, the *New York Herald* invited him to report on the America's Cup Race in October 1899. Erik Barnouw, *A Tower in Babel*, Oxford University Press, New York, 1966 at 13. Marconi and the directors of the Marconi's Wireless Telegraph Company, Ltd. decided to use this event as an opportunity to take advantage of business possibilities in the United States and planned to form an American subsidiary. Id. Use this in the Intro?

The above is probably from *Bodies, Ideas, And Dynamics: Historical Perspectives On Systems Thinking In Engineering* by David A. Mindell, emphasis added by CTW for use in book.


1
2
3
4
Summ + Conclusion
+bridge
summary
new overall
concls

say nothing of renouncing the jejune ideal of perpetual exploration and permanent revolution. We need to overcome the now old modern myth of new beginnings and recognize that the Heroic Generation achieved so much of permanent value because they were formed in a church culture already shaped by a refined, cogent, and considered standard theology.

A theologian friend recently made the plaintive observation that our generation seems to lack thinkers of the stature of previous generations. Is that so surprising? We lack the coherent church culture that gave their theologies precision, depth, and scope. Theologians can innovate to their hearts' content, but without a standard theology the total effect of our efforts is far less than the sum of its parts.

Just what a renewed standard theology will look like I cannot say. But this much is clear: Instead of the current, misguided dismissal of the nineteenth- and early-twentieth-century figures, we need a cogent account of the basic shape and structure of the nineteenth-century theologies that gave rise to and were enriched by the first great council of the modern era, Vatican I, and informed the remarkable resistance of Catholicism to so many destructive trends in the modern era.

We need to recover the systematic clarity and comprehensiveness of the neoscholastic synthesis, rightly modified and altered by the insights of the Heroic Generation and their desire for a more scriptural, more patristic, and more liturgical vision of the unity and truth of the Christian faith. We need good textbooks—however much they might not satisfy a literary genius like Hans Urs von Balthasar and the soul of a poet like Henri de Lubac—in order to develop an intellectually sophisticated faith.

To overcome the poverty of the present, our generation must base its theological vision on a fuller, deeper form of *ressourcement*, one that discerns the essential continuity of the last two hundred years of Catholic theology. After an era of creativity, exploration, and discontinuity, much of it fruitful and perhaps necessary, we need a period of consolidation that allows us to integrate the lasting achievements of the Heroic Generation into a renewed standard theology. FT

Lost and Saved on Television

Ross Douthat

There was a time in American life, not so very long ago, when the only significant relation between religion and popular culture seemed to be the tedious symbiosis enjoyed by such envelope-pushing television producers as Steven Bochco and David E. Kelley and the conservative Christians who loved to hate them. The pattern repeated itself endlessly: Some line would be crossed (a bared buttock, a profanity, a dollop of anti-Catholic bigotry) and the Moral Majority or the Catholic League or the Traditional Values Coalition would mount a protest or a boycott, which in turn only ensured higher ratings for the television show in question and incentives for further envelope-pushing the next time around.

Today those battles are all but finished, and the religious side has lost. It was beaten in part by provocateurs like Bochco and the broader left-wing campaign against anything that even hinted at censorship. But it was also defeated by forces beyond the control of either artists or agitators. Technological change, above all, doomed the fight for decency in American popular culture, as every successive technological innovation weakened the power of regulators, moral and otherwise, while expanding the venues where human weakness could be exploited for fun and profit (mainly the latter). Russell Kirk famously called the automobile a "mechanical Jacobin," but the fissiparous, fragmenting effects of cable television, DVDs, and the Internet make the Model T look Burkean by comparison.

The result is the unrestrained and unrestrainable popular culture of today, where every concept, no matter how lowbrow or how vile, can find a platform and an audience. A television show that proves too violent for NBC ends up on Showtime; an FCC crackdown on a raunchy radio host only nudges him into a lucrative new spot on satellite radio; a community that manages to keep X-rated movies out of its theaters and video stores is just pushing money into the pockets of sleaze merchants who peddle their wares over high-speed Internet connections. Small wonder that America's movies and music and television shows make us enemies in traditional societies around the world—and small wonder, too, that many cultural conservatives, despairing of their country's future, embrace withdrawal from the world into a narrow, well-defended Christendom, where their families and their faith can be protected from the lowest-common-denominator swill that washes against the walls outside.

Yet religious believers have also profited in certain ways from the crack-up of the old middlebrow, PG-rated common culture, even if it's sometimes hard to see the gains through the gore and exhibitionism. This is the great paradox of twenty-first-century popular culture in America: For all its profanity and blasphemy, the new culture arguably takes religious issues and debates *more* seriously than it used to in a more decent, less decadent era.

Or perhaps it isn't a paradox at all: There was a time, after all, when many religious thinkers were skeptical of the kind of mass culture that had its American heyday at mid-century, critiquing its homogeneity and complacency, tackiness and philistinism. They rose to the defense of the old dispensation only because the alternative—the mainstreaming of the 1960s counterculture, with its contempt for every tradition and authority—seemed far worse. (*The Bells of St. Mary's* might not be *The Divine Comedy*, but it was better than *Basic Instinct*.)

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The counterculture has largely won, and our society is in many ways the worse for it. But there are opportunities in defeat as well as victory, and places where new life can spring up amid the ruins. The old gatekeepers were at best superficially conservative and favorably disposed to religion only because they believed in being inoffensive about every segment of the mass market on which their films and shows depended. Now the incentives to be uncontroversial are far weaker. Which means that, along with all the dreck and smut and mediocrity, there's more room for idiosyncrasy, controversy, and political incorrectness as well. These can be the raw materials of blasphemy, but they can also be the stuff of popular art that drills deep into issues—theology and human destiny, sin and redemption, heaven and hell—that the old mass media treated with kid gloves.

True, God has to compete with Paris Hilton and *Family Guy* for attention, but at least He's in there fighting.

Consider recent developments in science fiction and fantasy. These are genres that have traditionally provided fertile ground for metaphysically inclined fiction, but for a long time their presence in the American mass media began with *Star Trek* and ended with *Star Wars*—fun but shallow entertainments whose take on religion mixed Daniel Dennett with Deepak Chopra, secular condescension with New Age mumbo-jumbo. As late as the early 1990s, the only sci-fi show of any merit on television was *Star Trek: The Next Generation*, a U.N. bureaucrat's fantasy of the twenty-fourth century, in which a crew of asexual socialists in leotards kept the galaxy safe for cultural relativism and conflict resolution.

A decade later, the landscape looks very different. The cost of bringing what J.R.R. Tolkien called "a secondary world" to life has dropped, and the possibilities for creativity have widened. The two great Christian fantasies of the century just past—Middle-Earth and Narnia—have been given vivid, wildly successful big-screen treatments. The dreadful *Star Wars* prequels were briefly eclipsed by *The Matrix*, whose blend of religious allegory, pop philosophy, and balletic violence aimed much higher than George Lucas ever did (though *The Matrix* descended into pretentious incoherence in the later installments). And the best sci-fi show on television today is *Battlestar Galactica*, a "reimagining" of a short-lived late-1970s series about the last remnants of humanity fleeing a genocide perpetrated by their own creations—a race of humanoid robots called Cylons—and searching for our species' last refuge, a mythical planet called Earth.

The brainchild of a frustrated *Star Trek* scribe named Ronald Moore, *Galactica* is deliberately designed to be the anti-*Trek*: Instead of a bloodless, hygienic future in which the human race seemed to have outgrown every recognizable human aspiration on its way to outer space, the show depicts a star-faring humanity driven by familiar motivations—religious faith chief among them. At its best, *Galactica* is *The Longest Day* crossed with Samuel Huntington's *Clash of Civilizations*, chronicling a gritty man-versus-machine interstellar war (fought with bullets and nuclear weapons rather than the usual phasers and photon torpedoes) that has as much to do with theology as politics. The original series borrowed from Mormon cosmology, but the newer, better incarnation pits the Greco-Roman polytheism practiced by the humans (they worship the ancient Mediterranean pantheon, and each of their "Twelve Colonies" is named for a sign of the Zodiac) against the crusading monotheism of the Cylons, who are convinced that their human progenitors worship idols and that they themselves are God's latter-born, perfected children, destined to inherit the universe from a flawed and sinful humanity.

This may sound like an allegory designed for know-nothing liberals: crazy fanatical monotheists (think Osama Bin Laden or Jerry Falwell) pitted against tolerant pagans (think Berkeley, California, or maybe Burlington, Vermont). But Moore's show is far too clever to slide into that trap. The human polytheists, in practice, have a great deal in common with the Abrahamic monotheists of Planet Earth: They're a people of the book, divided between fundamentalists who take the sacred scrolls literally and more latitudinarian believers who don't, and divided, as well, on all the culture-war questions—notably abortion—that divide our own semi-Christian West. And the Cylon monotheism, too, appears riven by theological factionalism, with tenets that are open to quasi-Buddhist as well as Mosaic interpretations.

More interesting still, the fundamentalists in both faiths have a tendency to be proved right, and the skeptics wrong. Prophecies are fulfilled and ancient scrolls prove accurate, and the religious choice, in any given situation, is likely to be the right one. The Old Testament overtones of the show's conceit—twelve tribes looking for a promised land—aren't accidental, and as *Galactica*'s quest narrative proceeds, so does the audience's awareness that the story is unfolding according to some larger design.

Whether this design belongs to the Colonists' pantheon or the Cylons' single deity remains uncertain. Both sides, despite their theological differences, seem bound to a common destiny in ways that neither

understand; like Jews and Christians after Christ, they're joined in brotherhood and enmity, till the end of their quest or perhaps the end of time. But however their relation turns out, it's likely to dovetail with the show's overarching premise—the idea, at once old-fashioned and subversive, that human history has an Author.

The same set of issues—meaning and purpose, common destinies and divine interventions—dominates the action on *Lost*, ABC's addictive serial about the survivors of a plane crash who find themselves marooned on a South Pacific island, cut off from any hope of rescue. Most of the castaways carry secret sorrows or hidden sins: There are murderers and adulterers, drug addicts and former mental patients, an African warlord and an ex-torturer from the Iraqi Republican Guard. And the island is attuned to all of them in some mysterious fashion, speaking to the survivors in dreams and visions, pushing them into strange obsessions and dangerous quests, delivering healing to some and sudden death to others.

The creators of *Lost* have repeatedly denied that their characters are literally in purgatory, which was a popular theory among early viewers of the series, and most of the evidence from later episodes suggests that they're telling the truth. Still, the show's island is at the least a purgatorial landscape—it's no coincidence that several of the characters are Catholic, lapsed and otherwise—where the things that the castaways carry from their previous lives provide the raw material for suffering, struggle, and growth.

But the show has larger ambitions as well. The island isn't just a supernatural catalyst for individual redemption; it's a microcosm of Western modernity (many of the characters, not coincidentally, share names with modern political philosophers—there's a Rousseau and a John Locke, a Hume and even a Mikhail Bakunin), and a place where the two most powerful forces in recent human history, utopian hubris and scientific arrogance, have worked themselves out with what appear to be disastrous consequences.

At some point, long before the plane crash, the island was the site of an overlapping series of experiments on everything from genetic engineering and radical life extension to parapsychology and magnetism, which apparently involved cooperation between a sinister multinational corporation and a Walden II–style commune of idealistic scientists. The landscape is littered with the detritus of these efforts—abandoned hatches with cryptic instructional videos, empty zoos and laboratories, mysterious processes that may still be working themselves out—and populated by what appear to be the experiments' surviving custodians, a group of people known only as the Others, whose purposes remain inscrutable even as they emerge as the castaways' antagonists. The shadow of a larger apocalypse hangs over the narrative as well since, whatever the experiments were meant to do, they seem to have created the possibility of a world-ending cataclysm.

Meanwhile, the castaways are divided among themselves both personally and philosophically, constantly arguing over whether their lives on the island are governed by purpose or blind chance, and whether faith or reason is a surer guide in their strange circumstances. Some of the characters are Christian, others embrace a kind of New Age island-worship, others cling to a stringent materialism. At its best, the show seems capable of synthesizing all these elements and building to a metaphysical battle royale, in which the various forces at work in our own civilization struggle with one another for mastery, and nothing less than the fate of the world hangs in the balance. At it worst—well, *Lost* is in its third season now, and there are disturbing signs that the show is running out of steam, and that the creators may have thrown too many mysteries into the air without a plan to catch them. (This is known among television doctors as the *X-Files* Syndrome.)

However the saga of the castaways manages to finish up, though, it's clear that *Lost* ultimately shares with *Battlestar Galactica* a certain degree of cosmic optimism. With God (in some form) taking an active role in the narrative and nothing less than the fate of humanity hanging in the balance, it seems like a safe bet that the gates of hell won't prevail against the heroes. This is the nature of fantasy and epic, at least in the context of a Christian culture—by raising the stakes, the genre gives away the ending. Frodo will always destroy the ring; Aslan will always defeat the White Witch; Harry Potter will always put an end to Voldemort. A price will be exacted along the way, but, however dark the story gets, the logic of eucatastrophe still holds, and with it the knowledge that the light will overcome the darkness.

This eschatological optimism contrasts sharply with the pessimism of the best realistic show on television today: *The Sopranos*, which is ending its six-season run on HBO this spring. Where *Galactica* and *Lost* are shows about getting through purgatory to heaven, or at least a promised land, *The Sopranos* is a show about what it means to go to hell. Like *The Wire*, another HBO production (and the leading candidate for The Best Show on Television title once the Soprano family enters the afterlife of reruns), *The Sopranos* offers a devastating critique of American life. Unlike the kind of social commentary that Hollywood still churns out—in which everything would turn out bet-

ter if only conservatives weren't so busy oppressing homosexuals or women or maybe unionized employees—it isn't interested in easy sociological answers or cheap political point-scoring. And while even the best episodes of *Galactica* and *Lost* are ultimately pop-culture ephemera, HBO's mob show is closer to real art: Dostoevsky crossed with Emile Zola, a novelistic meditation on the nature of societal corruption and personal sin.

There have been pop-culture portraits of mob kingpins descending into hell before, of course—think of Michael Corleone fading into shadow at the end of *Godfather II*. But the artistic temptation is always to make this fall splendid and Miltonic, a matter of a few grand and tragic choices rather than the steady accretion of small-time compromises, petty sins, and tiny steps downward that usually define damnation.

The Sopranos dares instead to explore the terrible banality of evil, depicting ordinary people held prisoner by their habits and appetites who choose hell instead of heaven over and over again, not with a satanic flourish but with an all-American sense of entitlement. Sin is never glamorized or aestheticized: The violence is brutal rather than operatic, the fornications and adulteries are panting and gross rather than titillating. The characters' sins breed even physical dissolution: obesity, ulcers, hemorrhoids, constipation, cancer. The show offers a vision of hell as repetition, ultimately, in which the same pattern of choices (to take drugs, to eat and drink to excess, to rob and steal and bully and murder) always reasserts itself, and the chain mail of damnation—in which no sin is an island, and gluttony is linked to violence, sloth to greed, and so on—slowly forges itself around the characters' souls.

The only players in this drama who seem capable of escape are Tony Soprano himself, the mob boss and antihero who makes repeated excursions into psychotherapy, and his wife, Carmela, whose guilt over her husband's lifestyle coexists with an unwillingness to give up the possessions and status that his criminality has won for her. The arc of the show, over six seasons, has traced their attempts to leave their sins behind—Tony's dialogues with his therapist and halting steps toward self-knowledge; Carmela's religious forays, adulterous fantasies, and abortive quest for a divorce. These always end in failure, partially because the avenues they choose tend to be therapeutic rather than truly redemptive (the show is particularly hard on psychotherapy's pretensions) and partially because actually escaping seems to mean giving up too much: the combination of bourgeois comfort and the kind of "freedom" that the Mob life offers, a freedom to do as you please, unhindered by any societal restraint, that is gradually revealed as the worst prison there is.

In one of the show's darkest and most telling moments, Tony's nephew and lieutenant, Christopher, plans to betray the Soprano family and go into the witness-protection program with his fiancée, who has been blackmailed into becoming a government snitch. But while refueling his glossy black Hummer in a gas station, he finds his gaze drawn to the family across the pumps from him—the runny-nosed kids, the harried parents, and above all their battered station wagon—and in that instant decides that it's better to have his fiancée killed than to accept the constraints of life outside the mafia. The freedom to do whatever you like in this world, it turns out, is just another word for choosing your SUV over your lover.

Whether *The Sopranos*' creator, David Chase, believes in a literal hell I have no idea—but his show believes in it. Just as *Lost* and *Galactica* tease out their metaphysics through hallucinations and dream sequences, *The Sopranos* deals frequently in private visions—mainly Tony's richly detailed dreams, which are more psychological than metaphysical, but also a pair of theologically fraught near-death experiences.

The first belongs to Christopher, after a second-season car accident briefly stops his heart, and it lands him in hell, which turned out to be an Irish bar—every Italian's idea of the inferno—populated by deceased "soldiers" from his crime family, who give him a message to carry back to his bosses: "Three o'clock." (That hour of the day, with its Good Friday associations, has been associated with bad news for members of the Soprano family ever since.) The second near-death moment, meanwhile, belongs to Tony himself, a several-episode sojourn in limbo following his shooting at the hands of his senile uncle. It concludes with him literally going toward the light and finding himself at the door of a brightly lit family reunion, where his mother (a monstrous woman who once took out a hit on him) and the rest of his departed relatives have gathered to greet him.

Whatever afterlife waits for him aside, it clearly isn't heaven.

The question, of course, is whether the audience gets the point, or whether *The Sopranos*' faithful viewers are in it for the same reasons the mobsters are: the adrenaline rush that comes with any violent or sexual encounter, no matter how degrading it may be. This is the problem for any artist who seeks to show sin as it is. Does depicting an act make you complicit in it, even when you stand in judgment? *Last Tango in Paris* makes loveless sex look like hell on earth, for instance, but there are still people who watch

it for titillation, just as there must be some segment of *The Sopranos*' audience—young men, in particular—who spend their time cheering on the killers, identifying with the mobsters instead of profiting from their hell-bound example.

And even if *The Sopranos* isn't glamorizing sin, you only have to flip down a few channels to find a dozen shows that are. *Battlestar Galactica* may be a step up from *Star Trek*, in terms of both artistry and philosophical seriousness, but is it worth enduring the ever-vaster wasteland of basic cable to make that step up possible? Or again, is the chance to see the story of Christ's Passion as Mel Gibson reimagined it—blood-drenched and harrowing and brilliant—worth giving the same R-rated carte blanche to Quentin Tarantino, or worse, the makers of torture-porn thrillers like *Hostel* and *The Hills Have Eyes*?

This is an important argument for cultural conservatives to have, but for the time being it's also largely theoretical. The old standards for mass culture, on television and the silver screen—minimal violence, no nudity, and no ideological conflict that couldn't be solved by asking *What Would JFK Do?*—are long gone, and no political pressure is likely to revive them. Religious believers can take the risk of competing in this riotous marketplace, where there's a great deal to gain but even more to lose, or they can withdraw from it and tend their own cultural gardens, like the new St. Benedicts that Alasdair MacIntyre envisioned at the end of *After Virtue*. There doesn't seem to be a third way out.

And yet, whether they choose to withdraw or stay, believers should be wary of overstating either the horrors of the present era or the virtues of the American pop cultural landscape gone by. By a host of cultural indicators, American society was better off in the 1950s than it is today, and the constraint and self-censorship of that age's mass media had a great deal to do with this achievement. But the old order turned out to be built on sand, and the generation that was weaned on the movies and TV shows of the 1950s, with their League of Decency seal of approval, grew up to think of orthodoxy as a dead hand and tradition as an epithet. Today's generation, if they turn to the right channel and find the right show waiting for them, may instead discover the truth of Chesterton's dictum: "Every man who knocks on the door of a brothel is looking for God."

None of this means that religious believers, and particularly religious parents, don't have understandable reasons for trying to wall their families off from the worst of what American pop culture has to offer, whether by canceling their cable subscription or packing up and moving to Ave Maria Town.

But if they do, they ought to at least consider bringing a DVD player along with them. FT

Cornflowers

For those who paint and draw

I give you
for consideration
the reason why
cornflowers
defy
the certainty of
asphalt. Impediments
to progress are
often weed-like,
fragile-flowered.

Cornflowers will
persist; the unexpected
thrusts of blue
that line the cracks
of paved convenience
twinge the heart
a bit
to new recall.
Pray we do not
see the end of
cornflowers.

—Mary Enda Hughes, S.S.N.D.

story, narrative
Vail, Morgan
Indeps frustrated, [illegible]
Rockefeller / ?

Marconi
Fess = CW, voice, tuning (?)
deForest = vac tube — looking for better detector
Lodge et al = UHF, optical properties, of light
Armstrong here? or 1920's?

Alexanderson, GE
United Fruit
continuing role of US Navy (key player)

Spec 5
CTW has had effect
known players tradeoffs tech design, [illegible], finance

1615 L
#300
202 207-2924
Heather

Comparison of Anti-Jamming Technologies

Global Internet Freedom Consortium Internal Memo, http://internetfreedom.org, Feb, 2007

Note: This document contains proprietary information that shall not be disseminated to other parties unless permitted by the above Consortium in writing.

		DynaWeb	Ultra	Garden	Phoenix	Gpass	TOR	aNonymizer	MEGAPROXY	psiphon
General Information	Homepage	http://dongtaiwang.com/	http://www.wujie.net/	http://gardennetworks.com/	http://hfh.edoors.com/	http://www.gpass1.com	http://tor.eff.org/	http://www.anonymizer.com/	http://www.megaproxy.com/	http://psiphon.civisec.org/
	Core Tech	Dynamic IP and Encrypted TCP Traffic	Dynamic IP and Encrypted TCP Traffic	Dynamic IP and Encrypted TCP Traffic	Dynamic IP and Encrypted VPN	Dynamic IP and Encrypted socks proxy	Dynamic IP and Encrypted socks proxy	IP anonymization and Encrypted TCP	Encrypted Web VPN	Encrypted Proxy Server/Client
Abilities of surviving different jamming types	Blocking of key IPs or servers	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
	Blocking of dynamic IPs	Yes	Yes	Yes	Yes	Yes	No	No	No	No
	Active IP hunting by net police	Yes	Yes	Yes	Yes	Yes	No	No	No	No
	Traffic pattern blocking	Yes	Yes	Yes	Yes	Yes	No	No	No	No
	Survived severe, targeted jamming by CCP	Yes	Yes	Yes	Yes	Yes	Initial IP list is public. CCP could easily block this list.	No	No	No
Usibility	Easy to use	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No
	Interface design for Chinese users	Yes	Yes	Yes	Yes	Yes	No	No	No	No
	Chinese support forum	Yes	Yes	Yes	Yes	Yes	No	No	No	No
	Multi-language client software	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
	Special design for China's complex network	Yes	Yes	Yes	Yes	Yes	No	No	No	No
	Partner content platform	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Scalability	Current traffic (M hits/day)	20 M/day	20 M/day	10 M/day	5 M/day	5 M/day	??	??	??	??
	Potential users to support (K)	10000K	10000K	10000K	10000K	10000K	??	??	??	??
	Partner promote channels to China	Yes	Yes	Yes	Yes	Yes	No	No	No	No
	World wide IP resource	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Other	Effectiveness of funding	Service Quality and Client user increasing	Service Quality and Client user increasing	Service Quality and Client user increasing	Service Quality and Client user increasing	Service Quality and Client user increasing	??	??	??	??
	Notes									

Broadcast	Telecom
Wireless 1900-1920	Morgan, Vail
WWI, patents, etc.	
Davis Hoover Paley	Gifford? Indies (BCG, movies)
'34 Act	
Lasker / BBDO	FCC '39 report
WWII	
TV (microwave, Hollywood, UHF) Sarnoff Wasserman? '43 NBC Supreme Court decision	Long distance price / cost
Competition	
Cable freeze (who?)	MCI Topol, Goeken, McGuirk

Need new regulatory paradigm: OTP
Rostow Report

Examining the FCC's "Investigation of the Telephone Industry in the United States"

II. Introduction

In 1935, managing over five billion dollars in assets (nearly seven hundred billion dollars in 2006), the American Telephone & Telegraph Company (AT&T) controlled between eighty and eighty-five percent of local telephone service providers and over ninety-eight percent of long distance carriers.[1] Faced with a virtual monopoly of the telephone industry by AT&T, Congress approved a $750,000 allocation of funds to the Federal Communications Commission (FCC) to conduct extensive research into the history, status and future of the telephone industry.[2] In a report over six hundred pages in length submitted to the Committee on Interstate and Foreign Commerce on June 14, 1939, the FCC details the rise of AT&T to its monopolistic position, its business strategies and decisions, describes the then existing state of the telephone industry as a whole and concludes with recommendations for federal action.[3] This memorandum highlights some of the significant aspects of that study, relevant commentary and the aftermath of the investigation.

II. Purpose

Although the Interstate Commerce Committee was empowered to regulate rates in the telephone industry as early as 1910 with the passage of the Mann-Elkins Act, it refrained from doing so.[4] When the FCC was established in 1934, it decided to take a

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[1] Public Res. 8, 74th Congress, 49 Stat. 43, *Investigation of the Telephone Industry in the United States*, 76th Congress, 1st Session, House Doc. No. 340 (1939), (hereinafter referred to as '*Investigation*') at XXIII.
[2] *Id.* at XVII.
[3] *See generally Investigation.*
[4] William P. Barnett & Glen R. Carroll, *How Institutional Constraints Affected the Organization of Early U.S. Telephony*, 9 J. L. Econ. & Org. 98, 108 (Apr. 1993).

more active role but required adequate information to determine how best to regulate the industry.[5] While the necessary legislative authorization was already in place, the regulations remained but empty promises and were not exercised[6]. Although it provided a workable framework, the Mann-Elkins Act was originally drafted for railroad regulation.[7] Therefore, Congress considered certain modifications necessary to tailor and apply the legislation to communication.[8] Various groups lobbied for the inclusion or exclusion of particular proposals.[9] AT&T vehemently opposed a proposal granting the FCC control over certain service contracts between a parent company and a subsidiary.[10] In 1934, Congress ultimately agreed to exclude the proposal but required a Congressional study and report on the matter.[11]

On March 15, 1935 President Roosevelt approved of a joint resolution of the House and Senate "authorizing and directing the Federal Communications Commission to investigate and report on the American Telephone and Telegraph Company and on all other companies engaged directly or indirectly in telephone communication in interstate commerce."[12] The resolution granted broad discretion to the FCC to investigate the likes of the corporate and financial history of AT&T, service contracts, affiliations, the effect of mergers, consolidations, monopolistic control, propaganda, methods of competition, etc. [13] The study indicates that its official purpose was to "secure information on the telephone industry, particularly American Telephone & Telegraph Co., in aid of

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[5] *Id.*
[6] *Id.*
[7] *A Legislative History of the Communications Act of 1934* 6 (Max D. Paglin ed., Oxford: 1989).
[8] *Id.*
[9] *Id.* at 5-6.
[10] *Id.*
[11] *Id.* at 6.
[12] *Investigation*, appendix 1.
[13] *Id.*

legislation by the Congress and for the use of governmental agencies, including State regulatory commissions, for the information of the general public, as an aid in providing more effective rate regulation and for other purposes in the public interest."[14]

Unofficially, the public indicated dissatisfaction with lack of regulation of the industry. [15] The Progressive Era engendered a general anti-monopoly sentiment which carried over into the telephone industry in the 1930s.[16] Although AT&T had made certain concessions when faced with the threat of a DOJ antitrust suit in 1913, its effective monopoly continued. To avoid the suit, AT&T's then Vice President, M.C. Kingsbury drafted a letter to the Attorney General agreeing not to "acquire or control directly or indirectly" any competing company.[17] Known as the "Kingsbury Commitment," this agreement temporarily suppressed the public and governments' anxiety.[18] However, when AT&T learned to circumvent the terms of the agreement and continued expanding through acquisitions, the concerns resurfaced. [19] The high prices and near lack of competition in the booming telephone industry generated a general feeling of uneasiness and government distrust.[20] While bigwigs and institutional investors experienced a steady increase in industry profits, average consumers complained of exorbitant charges and inconsistent service.[21] The disconnect of local regulation resulted in significant variance across geographical sectors in prices, availability and quality of

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[14] *Id.*.
[15] *See generally* John Nix & David Gabel, *AT&T's Strategic Response to Competition: Why Not Preempt Entry?* 53 J. Econ. Hist. 377 (Jun. 1993). Alan Brinkley, *The Antimonopoly Ideal and the Liberal State: The Case of Thurman Arnold*, 80 J. Am. Hist. 557 (Sept. 1993); Joseph Willinhganz, *Debating Mass Communication During the Rise and Fall of Broadcasting*, Berkley Roundtable on the International Economy, Working Paper No. 74 (1994).
[16] *See* Nix & Gabel, *supra* note 10.
[17] *Supra*, note 7 at 8, *Investigation* at 139.
[18] *Id.*
[19] *Supra*, note 7 at 8, *Investigation* at 140.
[20] *See id.*
[21] *See id.*

telephone service. [22] Congress had been warned of the consequences of inaction in a 1934 special congressional committee report stating, "At the present time there is little, if any, Federal regulation of the rates, practices and charges of the several branches of the communications industry."[23] The report cited Congressional inefficiency as a major reason for the extant monopoly noting, "Telephone business is a monopoly- it is supposed to be regulated. Thus far, regulation, particularly by the Federal Government, has been nominal largely because Congress has not made appropriations sufficient to enable the Interstate Commerce Commission to give effect to existing statutes."[24]

Thus, through its investigation and eventual publication of its report, the FCC, empowered by Congress, hoped to quell public uprising and administer a workable system of regulation of the telephone industry, monopolized by a single corporate giant.

II. Conclusions

After three years of study, investigators determined that the root cause of AT&T's rise to monopoly status was its exclusive possession of basic telephone patents.[25] The expense of licensing fees or research and development to compete with the telephone giant was simply too great for most startup companies to bear.[26] AT&T took advantage of this situation with various mergers and consolidations with affiliates and other holding companies enabling AT&T to reach its ultimate goal of achieving a nationwide unified telephone system. [27] The report essentially concluded that long distance rates were far too

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[22] *Investigation* at 569.
[23] *Preliminary Report on Communications Companies* (H. Rept. 1273, 73d Cong., 2d sess. 1934).
[24] *See id.*
[25] *Investigation* at 573.
[26] *See id.*
[27] The Bell System's motto had consistently been "One System, One Policy, Universal Service." *Investigation* at 578

high as a result of AT&T's practical monopoly and that active federal involvement was necessary to ensure competition in the market and moderate prices for consumers.[28]

III. Results

In a simplified list, the investigation ultimately recommended more active regulation of the telephone industry as a whole.[29] The FCC championed amendments to the 1934 Communications Act finding that the requisite statutory framework was already present but practical application required revision in light of the study's conclusions.[30] Specifically, the report makes nine recommendations relating to accounting procedures, issuance of securities, licensing, rates and the jurisdiction of the FCC among others.[31] As a direct result of its deductions, the investigation boasted political changes which ultimately led to over $30,000,000 in direct savings to the American public.[32]

IV. Current Implications

Armed with better information, the federal government was able to implement a regulatory system better suited to oversight of a traditional "public utility" monopolized by private interest.[33] The significance of the investigation extended beyond application to the industry in the 1930s and 40s. It relayed important information about monopolies generally and their formation, effect on pricing, competition and the public conscience. This study and the Communications Act received special attention in the early 1990s during debates about a 1996 addition to the 1934 Act.[34] Renowned telecommunications

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[28] *Investigation* 597-600.
[29] *Id.*
[30] *Investigation*, *supra,* note 19.
[31] *Investigation* at 601.
[32] *Id.* at 602.
[33] *Id.*
[34] *See* Telecommunications Act of 1996, Federal Communications Commission, available at http://www.fcc.gov/telecom.html;

scholars regularly cite to key provisions of the investigation. [35] While no single provision or exhibit receives special attention, the analysis is frequently cited to support economic, historical and sociological studies alike.[36] Although the focus has evolved from regulation to active injection of competition in the telephone and other industries, this investigation will likely still hold significance for researchers, scholars and the government in years to come.

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[35] *See e.g.* John Shehan, *Integration and Exclusion in the Telephone Equipment Industry*, 70 J. of Econ. 249 (May 1956); Barnett, *Supra*, note 4; Richard Gabel, *The Early Competitive Era in Telephone Communication, 1893-1920*, 34 L. & Cont. Prob. (Spring 1969).

[36] *See id.*

Chapter 2 Notes

Following from Susan Douglas, Inventing American Broadcasting

Frontispiece: CTW excerpts:

> Telegraph without wires – how attractive it sounds.
>
> A little instrument that one can almost carry in the pocket, certainly in a microscopic grip, and if your correspondent be likewise equipped, you may arrest his attention and talk to him almost any time or place, with no intervening medium but the … ether… Possible? Certainly. But will it pay?

xxv re the popularization of inventors: they had harnessed electricity, what could be mre heroic or romantic? Electricity aheld a special place in the public's imagination.

xxvii vaudeville was the most popular form of entertainment in the public sphere, but with movies, phonograph, (and then later radio) a new alliance between technology and entertainment was of profound economic and cultural significance.

xxviii transition from "wireless" to "radio occurred between 1906 & 1912

9 1899 America's cup, Bennett, Herald, Stanley/Livingstone

10 scientific community dismissive of Marconi as nothing new

17 Marconi & mother go to England. Family forms company. Publicity by linking Queen's yacht to Prince of Wales health.

18 sends across English Channel 1899

19ff Yacht races in detail. Public notices, Herald front page, public display, NY Times,

25 Western Union "reviled monopoly".

25ff Newspapers self-interest in getting competition, lower prices than transatlantic cables charged. *New York Times*

26ff Press construction of meaning of wireless beginning 1899

31 American academic belittling of Marconi's work as nothing new, but he had a working total system.

35 Marconi worked by trial and error to achieve a commercial goal.

36 Marconi personality aloof humorless, self-centered

38 Marconi invents practical tuning to different frequencies. Crucial patent.

39-40 Marconi search for better detector. Patent of magnetic detector in 1902. earphones, operator discrimination of different transmitter tuning, faster, more robust, good on ships.

42ff Fessenden

45 Fessenden early work 1900 on continuous wave as preferable alternative to Marconi's spark.

46 Fessenden idea of using dynamo for transmitter instead of spark; places order with GE 1900.

48ff De Forest

52 Stone, tuning, American patent application 1900

53 De Forest again, need for personal celebrity

53ff Marconi goal of transatlantic service. Curvature of earth? Went for bigger and more powerful instead of more refined as were De Forest, Stone and Fessenden.

55 Marconi drive for succeeding first rather than technical perfection

56 spark a foot long, 200 miles

56 1901 yacht races, competition between De Forest and Marconi

57 Marconi success transmitting across Atlantic – letter "S".

57-58 Very positive press. "in the public mind, Marconi and wireless telegraphy are one; he is its creator." See footnote 69 for ref.

59 doubts from scientific community about his success. See article on whether he really did it (should be on desk).

** 62 rise of market for corporate securities, 1887-1902, see footnote book to check out, probably of more use to the Vail story.

64-65 Establishment of American Marconi, short on who took initiative. John Bottomley, E.H.Moeran

66 organization of Marconi company, businesslike, role of board, Marconi.

66 Finance & ownership of company???

67 Marconi goal to establish monopoly in wireless, to connect the British empire.

67 Douglas: company had two strategies:

- new ship-to-shore service – short term

- alternative to cable companies – long term

69-70 1899, company adopted two key financial policies:

- shipping companies needed shore stations to make ship-borne equipment worthwhile, i.e., system infrastructure (cf Bell decision to provide wires and telephones). So company built the shore stations and leased ship equipment along with Marconi operator to provide an end-to-end service

- Nonintercommunication rule: ship and shore stations would communicate only with other Marconi stations.

70 Mutually exclusive contract with Lloyd's - major step toward monopoly goal, self-fulfilling standard, cf Aitken 239, cf Windows, Galaxy, other?

73 American Marconi financially on its own

77 American Marconi slow to build shore stations, slow to build US market, little support from England.

78 Preeminence of British Navy, shipping helped Marconi as British company.

78-79 Importance of Marconi's personal skills and ease of dealing with corporate heads and heads of state.

79 American Marconi in preeminent position by 1912 ??? how???

TOC | **Previous Section:** Chapter XLII | **Next Section:** Appendix B

History of Communications-Electronics in the United States Navy, Captain Linwood S. Howeth, USN (Retired), 1963, pages 513-546:

Appendix A. Chronology of Developments in Communications and Electronics

640

Thales of Miletus noticed the phenomena of static electricity acquired by amber upon its being rubbed.

1600

William Gilbert first used the term "electric force" in his published volume "De Magnete." (England)

1630

Otto von Guerke developed the first frictional electric machine. (Germany)

1676

Olav Roemer discovered that light travels at a finite velocity. (Denmark)

1725

Stephen Gray discovered that electricity could be conducted as a current. (England)

1745

Pieter Van Musschenbroeck discovered the principle of the electrostatic condenser. This led to the invention of the Leyden jar. (Holland),

1749

Benjamin Franklin demonstrated that lightning is an electrical phenomena.

1776

The Continental Navy, forerunner of the U.S. Navy, was established. Ezek Hopkins was appointed Commander in Chief.

The Continental Congress issued naval signal instructions. They consisted of signals based upon the manipulation of sails and the positions from which flags were displayed.

1777

A squadron of Continental vessels, dispatched to intercept the British West Indian Fleet, was directed to develop and promulgate signals to assist in discovering the enemy and advising of his locations and strength.

1797

Captain Thomas Truxton, U.S. Navy, devised the first known American signal book using the numerary system, numeral pennants, and several repeater flags for signal displays. This signal book contained approximately 300 signals. Fog signals were made by gunfire. Night signals were made by lanterns and gunfire.

1800

William Herschel discovered the existence of infrared rays. (England)

1801

Sir Humphrey Davy exhibited an electric carbon arc light. (England)

1802

The U.S. Navy issued the Barron Signal Book, the work of Commodore John Barry, U.S. Navy, and Capt. James Barron, U.S. Navy. Basically, it was the same as the Truxton Signal Book, which it superseded, except that it was better organized.

1813

The first revision to the Barron Signal Book was promulgated to the U.S. Navy. Flags replaced pennants and shapes were added.

1815

As a result of slow communications, the Battle of New Orleans was fought 15 days after the signing of the Treaty of Ghent.

1819

Hans Christian Oersted discovered the magnetic properties of an electric current. (Denmark)

1820

Johann Schweigger invented the first practical galvanometer. (Germany)
James Bowman Lindsay conducted experiments in communications utilizing the conductive properties of water. (Scotland)

1821

Andre' M. Ampere propounded the relationship between electricity and magnetism. (France)

1824

The Secretary of the Navy assigned the responsibility for U.S. naval communications to the Board of Naval Commissioners.

1825

George Simon Ohm discovered the relationship between the flow of electric current, resistance, and voltage. (Germany)
Jean Francois Arago proposed that propagated sound waves be utilized to measure ocean depths. (Italy)

1827

Sir Charles Wheatstone developed an acoustic device for the amplification of weak sounds. (England)

1831

Michael Farraday developed electromagnetic induction formulae. (England) Joseph Henry demonstrated the principle of electromagnetic induction. Farraday published the results of his experiments a year earlier than Henry.
Joseph Henry discovered the properties of mutual inductance and self-induction. He also improved the electromagnet and constructed the first electrically operated bell.

1837

Samuel F. B. Morse made application for a U.S. patent for telegraph system. Sir Charles Wheatstone made application for an English patent on a similar system.

1838

Carl August von Steinheil discovered the use of the earth-return. (Germany)

Joseph Henry first produced high-frequency electric oscillations and discovered that a condenser discharge is oscillatory.

1841

Lt. Matthew Fontaine Maury, USN, appointed to command the U.S. Navy Depot of Charts and Instruments. In this capacity he instituted a program of taking exact measurements of ocean depths by naval vessels.

1842

Alexander Bain developed the basic principles of transmitting pictures by electrical means. (England)

1843

The U.S. Congress appropriated $30,000 for the erection of a telegraph line between Baltimore and Washington.

Samuel F. B. Morse, while experimenting with communication by conduction across water, concluded that electricity could be conducted by water without the use of wire.

Samuel F. B. Morse and Alfred N. Vail devised the Morse Code.

1844

Telegraph circuit between Baltimore and Washington placed in operation.

1847

The Rogers and Black Semaphore Dictionary was adopted by the U.S. Navy but the Barron Signal Book (U.S. Navy Signal Book) was retained for tactical purposes.

1849

After completing the development of an electric telegraph instrument utilizing an electromagnetic relay, John Walker Wilkins predicted that "telegraphing without wires might be a possibility." (England)

1851

The First International Telegraph Conference was held in Berlin, Germany. This Conference compiled the Continental Code using 11 letters of the Morse Code.

1853

A. H. L. Fizeau shunted a Leyden jar across the terminals of the interruptor of an induction coil, thereby increasing the width of the spark gap and the efficiency of the coil. (France)

1854

Lt. Matthew Fontaine Maury, USN, attempted to measure ocean depths by underwater explosion, but was unsuccessful because he did not use a direct connection between the ear and the sea.

1856

S. A. Varley patented an induction coil, forerunner of the alternating current transformer. (England)

1857

Leon Scott developed an instrument for recording sound. (France)

1858

First transatlantic telegraph cable was opened.

The U.S. Navy Signal Book was revised. The Bureau of Ordnance and Hydrography was assigned the responsibility for signals and ciphers.

1859

Julius Plucker observed cathode rays. (Germany)

1861

Philip Reis designed a make-and-break platinum contact microphone capable of transmitting musical

sounds but not speech. (Germany)
Civil War began in U.S. and a revised signal book was issued to the U.S. Navy.

1862

The Bureau of Navigation was assigned the responsibility for signals and ciphers. The U.S. Navy was directed to adopt the U.S. Army wire telegraph system of signals.

1865

Heinrich Daniel Ruhmkorff designed a radically improved induction coil. (Germany)
Civil War ended in U.S.

1867

James Clerk Maxwell predicted the actions of electromagnetic waves. (Scotland)

1869

The U.S. Navy Signal Office was established. A new U.S. Navy Signal Book was issued.
The U.S. Naval Observatory, the Washington Fire Alarm Telegraphic Office, and the Washington Western Union office were connected by telegraph lines for the purpose of providing a nationwide exact time service from the Observatory. From this service originated the well-known phrase, "Naval Observatory Time."

1870

Von Bezold discovered that the oscillations set up by a condenser discharge were of varying frequencies which created mutual interferences. (Germany)

1872

The U.S. Navy Signal Office issued the first American edition of the International Signal Code to facilitate communications between the Navy and the merchant marine.
The first patent for a wireless communication system was issued in the United States to Dr. Mahlon Loomis of Washington, D.C. It was based upon a drawing illustrating how the setting up of "disturbances in the atmosphere would cause electric waves to travel through the atmosphere and ground."

1873

Joseph May discovered the photoelectric property of selenium. (Ireland)

1874

Karl Ferdinand Braun discovered that galena-copper pyrites and other metallic sulphides offered higher resistances to the passage of an electric current through them in one direction than in the opposite direction. (Germany)

1875

Alexander Graham Bell invented the telephone.

Thomas Alva Edison observed the phenomenon of "etheric force".

John Kerr discovered the polarizing property of a nitrobenzene solution subjected to high voltage. This lead to the development of the Kerr cell which was a vital component of early television projectors which utilized mechanical scanning systems. (Scotland)

The U.S. Navy experimented with electric lights for visual signaling purposes.

Lord Kelvin developed the first practicable pressure tube for measuring water depths of less than 100 fathoms.

1876

The U.S. Navy adopted the English Morse telegraphic code.

1877

Lt. W. N. Wood, USN, perfected a system of electric lights for transmission of the English Morse telegraphic code.

Thomas Alva Edison developed apparatus which gave the first audible reproduction of recorded sound.

Emile Berliner observed that the resistance of a loose contact varies with pressure and applied this to microphone design.

Thomas Alva Edison patented a telephone transmitter of the variable resistance amplifying type using a button of solid carbon as the resistance element.

1878

Sir William Crookes invented the Crookes tube and demonstrated the properties of cathode rays. (England)

David E. Hughes was among the early discoverers of the phenomena controlling the action of the coherer. In experiments made in developing an inertia transmitter, he utilized a steel needle in loose contact with a piece of coke. This was essentially a self-restoring coherer. (England)

The signaling method of Wood, devised in 1877, increased the U.S. Navy's range of flashing lights from 6 to 16 miles.

1880

Jacques and Pierre Curie discovered the piezo-electric effect of quartz crystals. (France)

Julius Elster and Hans Geitel experimented with glass bulbs, both vacuum and gas filled, which contained a metal plate and an electrically heated wire, and observed that electrified particles were radiated by the wire in all directions. (Germany)

1882

Professor Amos E. Dolbear was granted a U.S. patent for a wireless system.

1883

Edison discovered that an electric current can be made to pass through space between a hot filament and an adjacent metallic plate. This was later called "Edison Effect."

1884

Paul Nipkow was granted a German patent on a television scanning disc. (Germany)

1885

Sir Williams Preece transmitted telephonic speech over 1,000 feet by conduction. (England)

1886

Prof. Amos E. Dolbear was granted a patent on a wireless system which utilized two elevated metallic conductors.

Prof. Heinrich Hertz proved that electromagnetic waves could be transmitted through space at the speed of light. This confirmed Maxwell's Theory. He also demonstrated that these waves could be reflected and refracted.

Alternating current was utilized for the first time in the United States in a commercial lighting system.

1888

Lt. (later Rear-Adm.) Bradley A. Fiske, USN, conducted experiments in communications between ships by conduction.

1890

Prof. Edouard Branly developed the coherer. (France)

Julius Elster and Hans Geitel developed the first phototube. This was sensitive to both visible light and ultraviolet rays. (Germany)

The responsibility for signals, ciphers and signaling equipment was transferred to the Bureau of Equipment. The U.S. Navy Signal Office was abolished.

1891

Nikola Tesla was granted U.S. Patent 454,622 on the "Tesla Coil." This coil was designed to produce a current of very high potential and very high frequency. During the same year, while experimenting with high-frequency currents, he discovered the principle of the rotary magnetic field and applied it to the induction motor.

The Ardois system of signaling by lights was introduced in some squadrons of the U.S. Navy.

1892

Sir William Preece signaled between two points by a system which employed both induction and conduction. This resulted in the appointment of a royal commission to investigate the practicability of the use of his system for communication between lightships and shore. (England)

In a speech before the Royal Academy, Sir William Crookes commented upon electromagnetic waves: "Here is unfolded to us a new and astonishing world, one which is hard to conceive should contain no possibilities of transmitting and receiving intelligence." (England)

1895

Guglielmo Marconi transmitted and received his first radio signals. (Italy)

Captain Henry Jackson, Royal Navy, commenced radio experiments in the British Navy. (England)

Alexander S. Popoff reported he had transmitted and received radio signals a distance of 600 yards utilizing Hertz apparatus and a coherer. (Russia)

Emile Berliner obtained U.S. Patent 548,623 for a method of recording sound on a flat disc of hard rubber.

1896

Guglielmo Marconi transmitted and received radio signals over a distance of 2 miles. (England)

Capt. William Jackson, Royal Navy, was successful in establishing radio communication between two ships. (England)

1897

The Telephotos system of signaling by lights replaced the Ardois system in the U.S. Navy.

Radio messages were exchanged between Layernock, South Wales, and the Island of Flatholm, a

distance of 3½ miles. (England) (11 May)

The Wireless Telegraph Co. & Signal, Ltd., was incorporated. (England)

Marconi was granted U.S. Patent 586,193 on his radio system.

Marconi officially demonstrated the use of radio between ship and shore. Signals transmitted from San Bartolomeo were received on the Italian warship *San Martino* over a distance of 11 miles. (Italy) (20 July)

Marconi, embarked in a tugboat, received radio messages transmitted from the Isle of Wight, distant 18 miles. (England)

Karl Ferdinand Braun constructed the first cathode ray oscilloscope capable of scanning with an electric beam. (Germany)

1898

The Kingstown Regatta was reported by radio to a Dublin newspaper from the steamer *Flying Huntress*. (Ireland)

Lloyds established three radio stations, one on the northeast coast of Ireland, one on Rathlin Island Lighthouse and the other at Bally Castle. (England)

Upon the outbreak of war with Spain the Secretary of the Navy directed the establishment of a U.S. Coast Signal System on the Atlantic and gulf coasts. This system was the predecessor of the U.S. Naval Communication System.

U.S. cut cables landing in Philippines and Cuba.

M. I. Pupin granted U.S. Patent 713,045 covering an electrolytic detector. (1 Apr.)

Sir Oliver Lodge granted U. S. Patent 609,154 on method of radio tuning. (Aug.)

Marconi conducted radio communications between South Foreland Lighthouse and East Goodwin Sands Lightship, a distance of 12 miles. (England)

1899

Marconi communicated across the English Channel by radio. (England)

The French Navy installed radio equipment on a gunboat. (France)

The East Goodwin Sands Lightship flashed the first radio distress signal after being struck by the steamer *R. F. Mathews*. (England)

United States Army Signal Corps established radio communications between Fire Island and Fire Island Lightship, a distance of 12 miles.

Marconi radio equipment installed on H. M. S. *Alexandria*, *Europa* and *Juno* and used for the first time during maneuvers. Messages were exchanged for distances up to 75 miles. (England) (July)

The U.S. Weather Bureau compiled a complete report of the investigations made by Prof. Lucian Blake with an underwater bell and microphone in his endeavors to develop an underwater signal system which would provide warnings of dangers to navigation.

The first American radio company, the American Wireless Telephone & Telegraph Co., was incorporated. This company obtained the Dolbear patents. Harry Shoemaker and John Greenleaf Pickard were its radio engineers. (Sept.)

Marconi arrived in the United States to radio bulletins of the America Cup races to James Gordon Bennett's New York Herald. (11 Sept.)

The U.S. Navy, at the request of Rear Adm. R. B. Bradford, U.S. Navy, Chief of the Bureau of Equipment, appointed a board of four officers to witness and report on the operations of the Marconi

equipment during the radio reporting of the America Cup races.

Unfavorable weather delayed the beginning of the America Cup races from late September to October. Meanwhile, Admiral Dewey, who was returning from Manila to the United States, in the U.S.S. *Olympia*, via the Suez Canal and the Atlantic, had notified the Navy Department that he would arrive in New York on 30 September. Marconi was persuaded to go to sea with his equipment, contact the U.S.S. *Olympia* and make radio reports of her progress. Dewey anticipated his arrival date by 2 days and arrived in New York harbor just as Marconi was departing.

During a naval parade, staged in honor of Dewey, the SS *Ponce*, carrying Marconi and his apparatus and Lt. J. B. Blish, USN, one of the observing board, was assigned a place in the parade. During the parade the first official U.S. Navy radio message, from Blish to the Navy Department, was transmitted by Marconi. (30 Sept.)

Marconi's radio reporting of the races was a complete success and he was invited to demonstrate his equipment to the U.S. Navy.

A U.S. Navy Wireless Telegraph Board was appointed to investigate and report on the Marconi equipment to be tested in the U.S.S. *New York*, *Massachusetts* and *Porter* and at Navesink Light.

First official radio message from a U.S. naval vessel transmitted from the U.S.S. *New York* (2 Nov.)

U.S. Navy tests of Marconi equipment were completed. The Wireless Telegraph Board recommended that the system be given a trial by the U.S. Navy. (8 Nov.)

The Trans-Atlantic Times printed on the SS *St. Paul*, in which Marconi was a passenger returning to England, was first ship's paper to print news received by radio. Transmission of the news was from the Isle of Wight when the *St. Paul* was 56 miles distant. (15 Nov.)

Marconi Wireless Telegraph Co. of America organized. (22 Nov.)

The U.S. Navy offered to purchase 20 sets of Marconi equipment. Offer was countered by the Marconi interests with endeavors to enter into a lease agreement. This was refused and no further negotiations were conducted. The Navy then adopted a policy of watchful waiting.

1900

John Stone applied for a U.S. patent on a radio tuning device. (8 Feb.)

Marconi granted British patent for a tuned system of radio. (England) (26 Apr.)

William D. Duddell discovered that the electric arc could be made to generate high-frequency energy and succeeded in generating continuous oscillations of approximately 10,000 cycles per second. (England)

Nikola Tesla predicted radar.

Nikola Tesla granted a U.S. patent on control of distant objects by radio.

Prof. Reginald A. Fessenden, while in the employ of the U.S. Department of Agriculture, accomplished the first radio transmission and reception of speech.

The Wireless Telegraph and Signal, Ltd., was reorganized as the Marconi Wireless Telegraph Co., Ltd. (England)

Lt. Comdr. (later Rear Adm.) Bradley A. Fiske was granted a U.S. patent, underlying Tesla's, on the control of distant objects by radio. (23 Oct.)

Mr. A. J. Mundy and Prof. Elisha Gray conducted experiments with underwater sound.

1901

Emile Berliner developed a flat disk shellac composition record.

Commercial radio service established between the main Hawaiian Islands. (Mar.)

The U.S. Navy continued its policy of watchful waiting of radio developments.

Marconi's basic U.S. patent reissued as No. 11,913. Marconi, De Forest, and the American Wireless Telephone & Telegraph Co. participated in an attempt to report the America Cup races. The latter firm by creating intentional interference, prevented the transmissions of the other two participants from being received. (Sept.)

Comdr. F. M. Barber, USN (retired) recalled to active duty for the purpose of studying and reporting upon the development and use of radio equipment in Europe. (1 Oct.)

The Wireless Telegraph Co. of America (De Forest) organized.

St. Johns, Newfoundland received the letter "S" transmitted from Poldhu. This is considered to be the first reception of a transatlantic radio signal. (England) (12 Dec.)

The accomplishments of Mundy and Gray in developing an underwater sound system led to the formation of the Submarine Signal Co.

1902

The Chief of the Bureau of Equipment, Navy Department, recommended the U.S. Government take action to exercise control over radio stations.

U.S. Navy Department issued instructions for preparing the masts of naval vessels for fitting with radio antennas.

The De Forest Wireless Telegraph Co. was incorporated. It absorbed the Wireless Telegraph Co. of America. (Feb.)

The Consolidated Wireless Co. was incorporated and absorbed the American Wireless Telephone & Telegraph Co.

Marconi, embarked in the SS *Philadelphia*, recorded Poldhu's transmission up to a distance of 1,551 miles. (England)

The unsavory promotion of radio stocks began. Cornelius D. Ehret applied for the first patent on frequency modulation. (10 Feb.)

The Navy Department directed Comdr. F. M. Barber, USN (retired), to purchase two complete radio sets from each of four European firms; Slaby-Arco and Braun-Siemans-Halske of Germany and Ducretet and Rochefort of France. (Mar.)

Kaiser Wilhelm of Germany, concerned with the monopolistic attitude of the Marconi interests, proposed holding an international radio conference.

U.S. Navy constructed radio stations at Annapolis, Md., and Washington, D.C., for testing and evaluating radio apparatus.

Lt. J. M. Hudgins, USN, and two assistants, Chief Electrician's Mates J. H. Bell and William C. Bean, were sent to Europe to study the equipments being purchased. (May)

Marconi introduced the magnetic detector. (England) He was granted four U.S. patents (884,986 through 884,989) on this device. (25 June)

Prof. R. A. Fessenden introduced the electrolytic detector.

The National Electric Signaling Co. was formed by two Pittsburg entrepreneurs, Messrs. Hay Walker and Thomas Given, for the purpose of developing Fessenden's patents into a complete and saleable system.

Stone Telephone & Telegraph Co. was incorporated to exploit the inventions of John Stone.

Massie Wireless Telegraph Co. was formed under the direction of Mr. Walter Massie as both a manufacturing and operating organization.

The Chief of the Bureau of Equipment, U.S. Navy, stated that it was not necessary that transmitters

and receivers be of the same manufacture to provide radio communications.

The Secretary of the Navy convened the Wireless Telegraph Board, Comdr. Conway H. Arnold, USN, senior member, to supervise trials and determine apparatus best suited to U.S. Navy requirements. (14 Aug.)

Navy Department requested the De Forest Wireless Telegraph Co. of America, the Fessenden interests and Nikola Tesla to submit bids for the provision of radio equipments.

Tests of European equipments conducted between Annapolis, Washington and U.S.S. *Prairie* and *Topeka*.

The Wireless Telegraph Board submitted an interim report which pointed out the superiority of the Slaby-Arco equipment. (3 Dec.)

The De Forest Wireless Telegraph Co. delivered two sets of equipment for test. Neither Fessenden nor Tesla submitted equipments.

1903

The International Wireless Co. was incorporated and absorbed the Consolidated Wireless Co. (Feb.)

The U.S. Navy contracted for 20 Slaby-Arco equipments. (27 Mar.)

The National Electric Signaling Co. (Fessenden) stated that no notification of Navy tests had been received by it.

Fessenden patented the "Barretter," an electrolytic detector. (5 May)

The Bureau of Equipment informed Fessenden of previous correspondence of which he claimed to be unaware. He was then again requested to submit bids, which was promptly done. Later, he proposed that he provide two sets at his company's expense for testing by the Navy Wireless Board. He was directed to contact the president of that Board.

Fessenden withdrew his offers to provide equipment for tests, claimed that his patents were being infringed and that American radio manufacturers were being discriminated against by the U.S. Navy.

Eight major ships of the U.S. Navy were fitted with radio. Five naval shore radio stations of the North Atlantic coast were placed in operation. (July)

The U.S. Navy used radio for tactical purposes for the first time during the fall maneuvers.

The First International Radio Conference convened in Berlin to draft a protocol for consideration by the participating governments as the basis of a future convention. One of the articles of the protocol required all coastal stations to accept radio messages regardless of system in which originated. The Marconi interests opposed this article. The U.S. delegates were the most active of all members. (Aug.)

The Bureau of Equipment ordered an additional 25 sets of Slaby-Arco equipment. (10 Sept.)

Marconi interests proposed providing equipment to the U.S. Navy for a fixed amount to be considered as "life rental" of equipment but refused to have the efficiency of its equipment judged by Navy tests.

The SS *Campania* began publishing first daily shipboard newspaper from information and news items provided by radio.

The Radio Division of the Bureau of Equipment was established under Lt. A. M. Beecher, USN.

A radio school was established at the Brooklyn Navy Yard to provide electrician's mates instruction in radio operation and maintenance.

De Forest was granted U.S. Patent 887,069 on a magnetic detector.

"Instructions for the Use of Wireless Telegraph Apparatus" were prepared by Lt. J. M. Hudgins, USN, and issued the service.

General Electric Co. constructed its first high-low frequency alternator based on specifications provided by Fessenden. This alternator had a frequency of 10 kc.

The American De Forest Wireless Telegraph Co. established. In another unsavory stock manipulation

this company rented the De Forest Wireless Telegraph Co. for $500 per annum.

Rear Adm. G. A. Converse, USN, became Chief of the Bureau of Equipment.

Lt. J. M. Hudgins, USN, became Head of the Radio Division.

1904

The American De Forest Co. absorbed the International Wireless Co. and cancelled stock in the latter company which was valued at $500,000 (Jan.)

The London Times, using De Forest radio equipment, endeavored to provide first-hand news from the scene of action during Russo-Japanese hostilities.

The De Forest interests exhibited radio at St. Louis World's Fair.

Lt. J. L. Jayne, USN, became Head of the Radio Division.

Harry Shoemaker, formerly of the International Wireless Co. and John Firth, one of the original backers of De Forest, formed the International Telephone & Telegraph Construction Co.

In answer to Fessenden's claim that his patents were being infringed the Secretary of the Navy informed him that the Navy had no jurisdiction over infringement claims.

Fessenden agreed to provide the U.S. Navy with radio equipment for tests, but only under protest. The Navy would not agree to test Fessenden's equipment unless the tests were conducted under the same conditions applied to other firms.

John W. Griggs, former Attorney General of the United States, became president of the Marconi Wireless Telegraph Co. of America. (28 Apr.)

Fessenden agreed to supply two complete radio stations at a cost of one dollar, each.

Rear Admiral Henry M. Manney, U.S. Navy, appointed Chief of the Bureau of Equipment.

President Theodore Roosevelt appointed an interdepartmental board to consider the use of radio by the U.S. Government. (24 June)

U.S. Navy requested bids from the American De Forest Wireless Telegraph Co. and the National Electric Signaling Co. for four guaranteed long-distance stations to be constructed at San Juan, Puerto Rico, Guantanamo Bay, Cuba, Key West, Fla., and the Canal Zone. Contract awarded to the De Forest Co. (June)

By this date 24 U.S. Naval vessels were fitted with radio and 19 naval shore radio stations had been established. (30 June)

The Interdepartmental Board (Roosevelt Board) recommended that the U.S. Navy assume responsibility for all Government radio except that required by the Army. The latter was not to interfere with the Navy's coastal radio system. (12 July)

American Marconi interests protested the Roosevelt Board's recommendations.

Marconi interests again endeavored to persuade the U.S. Navy to accept a Marconi monopoly of radio. This was firmly refused. During this period the Navy reiterated the opinion that no radio station should be allowed on the coasts of the United States which would not accept messages from any properly tuned ship's apparatus, regardless of equipment used.

President Roosevelt approved and directed implementation of the recommendations of the Interdepartmental Board. (29 July)

U.S. Navy commenced daily transmissions of time signals. (9 Aug.) From this date it continued to expand and improve this service and until 1927 it remained the sole agency in the world making radio transmissions of this vitally important "Aid to Navigation."

U.S. Navy tested National Electric Signaling Co. equipment and although it did not meet the promises of Fessenden, three sets were purchased.

Lt. (later Rear Adm.) S. S. Robison, USN, became Head of the Radio Division.

"Instruction for the Transmission of Messages by Wireless Telegraphy, U.S. Navy, 1904" were issued. These superseded instruction issued in 1903.

The National Electric Signaling Co. protested the Government's actions in purchasing Slaby-Arco equipments, claiming that such action with the development of their system.

The U.S. Navy issued instructions for all radio-equipped naval vessels to transmit meteorological data to U.S. Weather Bureau not less than once daily. (Nov.)

Throughout the entire year Fessenden constantly berated the U.S. Navy with infringement claims and for redress in the matter of royalties.

Prof. John Ambrose Fleming applied for British patent on the two electrode tube. (England)

1905

The Navy Department and the Department of Commerce and Labor jointly drafted legislation for governmental supervision of commercial and amateur radio operations. This was strenuously opposed by American Marconi and National Electric Signaling Co. interests and was not transmitted to Congress. (Jan.)

Fessenden apparatus installed on three major men-of-war. In tests it failed to satisfactorily meet naval needs.

The U.S. Navy adopted the Continental Morse Code.

The harsh 60-cycle emissions of the early transmitters softened by U.S. naval personnel increasing the number of segments of the mercury turbine interrupters to provide a 500-cycle note.

American De Forest Wireless Telegraph Co. completed installation of equipment at the U.S. Naval Radio Station, Key West, Fla. (Mar.)

Fleming granted U.S. Patent No. 803,684 on the two-electrode tube as a detector. (19 Apr.)

Judge William K. Townsend, U.S. circuit court, rendered decision in favor of Marconi in a suit against De Forest for infringement of basic patents.

The Wireless Telegraph Board ceased to function. Thereafter decisions as to type of equipments purchased were made by the Radio Division.

A U.S. circuit court rendered decision in favor of National Electric Signaling Co. in suit against the American De Forest Wireless Telegraph Co. for infringement of Fessenden's patent on the electrolytic detector. (Oct.)

Tests of equipment provided by the Stone Telephone & Telegraph Co. completed and eight sets purchased by the Bureau of Equipment.

Based upon the operational success of the equipment of the Massie Wireless Telegraph Co. 10 sets of their equipment were purchased by the U.S. Navy.

The U.S. Navy purchased 21 sets of radio equipment manufactured by the International Telephone & Telegraph Construction Co.

The U.S. Navy issued the first "International Radio Call Sign Book."

American De Forest Wireless Telegraph Co. completed all the radio installations under its contract except the one at Guantanamo Bay, Cuba. (Dec.)

1906

U.S. Atlantic Fleet conducted exercises over large ocean areas in an endeavor to develop the strategical use of radio. These exercises were unsatisfactory because of short ranges of equipments and interference. The failure of these exercises caused senior naval officers to lose confidence in the

reliability of this method of communications and set back its development for naval use for several years.

American De Forest Wireless Telegraph Co. completed the installation of equipment at U.S. Naval Radio Station, Guantanamo Bay, Cuba. (Mar.)

The first disaster use of naval radio followed the San Francisco earthquake. The U.S.S. *Chicago* provided the only reliable means of rapid communication between the city and the outside world.

The National Electric Signaling Co. protested Navy's purchase of electrolytic detectors from American De Forest Wireless Telegraph Co. claiming infringement. The Secretary of the Navy directed the purchasing authority to disregard the protest.

Fessenden addressed a letter to President Theodore Roosevelt in an attempt to have Secretary of the Navy Bonaparte removed from office. A copy of this letter bears Fessenden's notation. "No reply received."

Lt. Robison prepared the "Manual of Wireless Telegraphy for Use of Naval Electricians." With revisions, it served as a standard textbook on the subject for the next two decades.

Lt. Comdr. Cleland Davis, USN, became Head of the Radio Division.

Fessenden continued to berate the Navy because it did not purchase National Electric Signaling Co. equipment. The Navy advised him that the excellent merit he claimed for his equipment was not sustained and that his bids were entirely too high.

Direction finding equipment developed by John Stone Stone experimented with in the U.S.S. *Lebanon*. It was not successful because it necessitated swinging ship to obtain maximum signal intensity and because little was known of the deviation caused by closed electrical loops inherent in ship construction. (Sept.)

Amateur and commercial radio interferences in the Boston area prevented transmission of messages to President Roosevelt in the U.S.S. *Mayflower* off Cape Cod, Mass. As a result of this the President directed the commander in chief, U.S. Atlantic Fleet, Rear Adm. R. D. Evans, USN, to make recommendations for the control of radio transmissions.

Second International Radio Conference convened in Berlin. Twenty-seven sovereign powers were represented. The U.S. delegation was headed by Ambassador Charlemagne Towers and consisted additionally of Rear Adm. Henry M. Manney, USN, (retired), Brig. James Allen, USA, Mr. Henry Waterbury and Comdr. F. M. Barber, USN (retired). (3 Oct.)

De Forest applied for a U.S. patent on the three-element vacuum tube. (25 Oct.)

The convention adopted by the Second International Radio Conference required compulsory handling of messages originating from or destined to ships, the compulsory handling of distress messages and the establishment of an international bureau at Berne for providing exchange of information. The efforts of the U.S. delegation were instrumental in the adoption of the first two mentioned articles. (3 Nov.)

Max Wein devised a form of quenched gap for spark transmitters. (Germany)

General H. C. Dunwoody, USA (retired), discovered the rectifying properties of carborundum crystals.

John Greenleaf Pickard discovered the rectifying properties of silicon.

By the end of this year many ships and shore radio stations of the U.S. Navy were fitted with composite radio equipments (transmitters and receivers of different manufacture).

Fessenden transmitted speech from Brant Rock, Mass., which was received at Macrahanish, Scotland. He utilized a 500-cycle spark transmitter. (Nov.)

The American De Forest Wireless Telegraph Co. obtained the controlling interest in and absorbed the International Telephone & Telegraph Construction Co.

United Wireless Telegraph Co. was organized by Abraham White (Schwartz). The assets of the American De Forest Wireless Telegraph Co. were transferred to the new company and De Forest was ousted, receiving $500 for his patents, excluding the three-element tube.

The General Electric Co. built a high-power low-frequency alternator (80 kc.).

Fessenden transmitted music and speech from Brant Rock, Mass., by means of the 80-kc. alternator provided by the General Electric Co. These transmissions were received by ships off the Virginia coast. (24 Dec.)

The Stone Telephone & Telegraph Co. became insolvent.

1907

De Forest applied for a U.S. patent on the three-element tube.

De Forest obtained rights to John Stone Stone's tuned circuit patent.

De Forest Radio Telephone Co. incorporated.

Christopher Columbus Wilson ousted Abraham White from the United Wireless Co. and intensified the stock-peddling policy of the company.

The U.S. Navy commenced transmitting hydrographic bulletins containing "Notices of Dangers to Mariners." (7 Aug.)

De Forest radio telephone equipment tested in U.S.S. *Connecticut* and *Virginia*. (Sept.)

The U.S. Navy contracted for 26 sets of De Forest radio telephone equipment for installation on ships of the "Great White Fleet" prior to their departure on their "Around the World Cruise." (Nov.)

Arthur Korn transmitted a picture by landline from Berlin to Paris. (Germany)

Boris Rosing and A. A. Campbell-Swinton separately and at about the same time published treatises on electrical transmission of pictures using electromagnetic scanning. (Russia-England)

Crystal detectors came into general use, replacing electrolytic detectors and coherers.

De Forest demonstrated radiotelephony between a ferry of the Lackawanna Railroad Co. and their Hoboken and New York City terminals.

1908

While in port at Rio de Janeiro, Brazil, U.S.S. *Ohio* broadcast music by radio.

The Marconi interests began limited and unreliable commercial radio service between Glace Bay, Nova Scotia and Clifden, Ireland. (England)

De Forest granted U.S. Patent No. 879,532, on the three-element vacuum tube. (8 Feb.)

Rear Adm. R. D. Evans, USN, directed dismantling De Forest radio telephone equipments installed in "Great White Fleet" because they were being used improperly and because they interfered with normal radio communications. U.S.S. *Ohio* was allowed to retain its installation for experimental purposes. (Mar.)

The first Alaskan radio expedition erected and placed in operation the U.S. Naval Station, Cordova, Alaska.

The U.S.S. *Connecticut* en route from Hawaii to New Zealand, exchanged messages with U.S. Naval Radio Station, Point Loma, Calif., at a distance of 2,900 miles.

The Bureau of Navigation promulgated a revision of the "U.S. Navy General Signal Book, 1898," which consisted of three parts: General Signals, which included a telegraphic dictionary; Tactical Signals; and Boat Signals. The use of the first-mentioned section was restricted to commissioned officers.

A 20-kc. alternator with a power output of 2,500 watts was constructed by the General Electric Co.

Poulsen developed an arc transmitter, the transmissions of which were received 150 miles away. (Denmark)

The U.S. Navy purchased two arc transmitters and receivers from Poulsen of Denmark.

The U.S. Senate failed to ratify the Berlin Convention of 1906.

The U.S. Naval Radio Research Laboratory established under the direction of Dr. L. W. Austin.

The first U.S. Navy civilian radio expert, George H. Clark, appointed. He was assigned duties as an assistant to Dr. Austin of the U.S. Naval Radio Research Laboratory and to the Head of the Radio Division, Bureau of Equipment. (Aug.)

The U.S. Naval Radio Research Laboratory conducted experiments with the Poulsen arc transmitter and "tikker receiver" and recommended against their use because of the inadequacy of the receiver. This delayed the U.S. Navy's adoption of continuous wave transmission for approximately 4 years.

1909

The SS *Republic* collided with SS *Florida* off New York. Radioed calls for assistance resulted in keeping the loss of lives down to six persons and created such an impression upon the public that radio soon became looked upon as a seagoing necessity.

The House Committee on Merchant Marine and Fisheries favorably reported on a bill that would have required certain oceangoing vessels to be fitted with radio equipment manned by a capable operator. Congress failed to enact it into law. (Feb.)

The U.S. Navy contracted with the National Electric Signaling Co. for delivery of one 100-kw. synchronous rotary spark transmitter for installation in a shore radio station and two 10-kw. sets of the same type for installation in the U.S.S. *Salem* and *Birmingham*. The contract required that the shore station transmission be received, day or night by a ship distant 3,000 miles and that the ship transmitters would cover a minimum distance of 1,000 miles by day or night. (May)

Senator Frye introduced a bill into Senate requiring certain oceangoing vessels to be equipped with radio. (9 June)

Portable radio apparatus successfully service tested in the U.S. Atlantic Fleet.

The quenched spark gap, which energized the antenna circuit one or two impulses and then electrically opened the antenna circuit allowing the antenna to continue to oscillate at its own frequency, introduced in U.S. Navy in transmitters purchased from the Telefunken Co.

Tests of the Fessenden 100-kw. transmitter installed at Brant Rock, Mass. and the 10-kw. transmitters in U.S.S. *Salem* and *Birmingham* were unsatisfactory. (Dec.)

Congressman Roberts introduced a bill in the House which provided for the creation of a board of seven members, one each from the War, Navy and Treasury Departments, three from commercial interests and one unbiased scientist, to prepare, within 30 days of its organization, a comprehensive plan to govern the operation of all radio stations under the jurisdiction of the United States, giving due regard to all.

1910

The Roberts Bill reported out favorably by the House Committee on Naval Affairs.

Public Law 262 (Frye Bill), "The Radio Ship Act of 1910," passed the Senate and House and was approved to become effective on 1 July 1911. No further action was taken on the Roberts Bill.

Congress enacted legislation providing that in the future, the owner of any invention covered by a U.S. patent might recover reasonable compensation from the Government whenever their patents might be used by the Government without their consent.

Lt. Comdr. (later Rear Adm.) D. W. Todd, USN, relieved Lt. Comdr. Cleland Davis, USN, as Head of

the Radio Division.

The Bureau of Equipment was dissolved, and the responsibility for radio was assigned to the Bureau of Steam Engineering. Rear Adm. H. I. Cone, USN, was the first Chief of this Bureau. (30 June)

Further tests of Fessenden 100-kw. and 10-kw. transmitters were conducted by the Navy. They failed to meet contract requirements.

1911

R. A. Fessenden was dismissed from National Electric Signaling Co. He brought suit for breach of contract and was awarded damages amounting to $400,000. This forced the company into receivership. Prior to this, Fessenden had developed the heterodyne method of radio reception. He utilized a small arc transmitter to generate the local oscillations.

The Radio Ship Act of 1910 became effective. The Radio Division of the Department of Commerce and Labor was established to enforce this law.

Lack of Government supervision of radio activities resulted in increased chaotic conditions as Government, commercial, and amateur operators vied for use. Transmissions of vituperations, frivolities, and obscenities exceeded the time used for legitimate messages. The Department of Commerce and Labor could not legally cope with the situation.

The Federal Telegraph Co. of Calif., was incorporated. It owned the U.S. rights to the Poulsen arc transmitter patents. (July)

The Navy issued its first radiofrequency plan.

De Forest's Radio Telephone Co. instituted a plea of bankruptcy. De Forest obtained employment with the Federal Telegraph Co. of Calif.

The Alaskan radio expedition established temporary U.S. naval radio stations at Kodiak, Dutch Harbor, and St. Paul.

The "Rules for Autumn Practice, 1911" required the use of radio for the tactical maneuvering of the U.S. Atlantic Fleet during battle practice.

The U.S. Atlantic Fleet was unsuccessful in carrying out the radio provisions required by "Rules for Autumn Practice, 1911." As a result of this, it was recommended and approved that a radio officer be assigned the staff of the commander in chief, U.S. Atlantic Fleet. (Oct.)

Adm. A. G. Winterhalter, USN, in the U.S.S. *Washington*, conducted experiments in ranging, using radio and sound. The latter included transmissions in air and under water. This was the first attempt to determine position acoustically, and indicated the vagaries of sound in air and proved the greater reliability of underwater sound.

1912

F. A. Kolster developed a decremeter for the measurement of radiofrequencies.

Submarine bell warning systems, developed by the Submarine Signal Co., had been installed at dangerous points of navigation along the coasts of the United States, Canada, the British Isles, France, Portugal, Italy, Brazil, Chile, and China. Numerous shipowners installed listening devices to receive the signals of these warning bells.

The Marconi interests purchased the Bellini-Tosi patents, including those on direction finders. (England)

Dr. Irving Langmuir developed a high-vacuum electronic tube to provide a pure electron discharge.

Dr. H. D. Arnold concurred with Langmuir in the necessity of having a high vacuum in an electronic

tube. He believed that the instability of the existent three-element tubes was caused by the ionization of enclosed gases.

The U.S. Navy began providing postgraduate radio instruction for officers. Ens. (later Capt.) C. H. Maddox, USN, was registered at the Graduate School of Applied Science, Harvard University, where he studied under Prof. G. W. Pierce, one of the country's foremost radio engineers. (Feb.)

The British Government, which had extended the United States an invitation to attend the Third International Radio Conference, withdrew its invitation because of our failure to ratify the Berlin Convention.

The U.S. Senate ratified the Berlin Convention of 1906. This ratification was ably supported by Rear Adm. John R. Edwards, USN. (3 Apr.)

Radio aided in reducing the loss of life in the S.S. *Titanic* disaster. This disaster indicated the necessity of maintaining a continuous radio watch at sea. (14 Apr.)

The U.S. Navy was directed to use the term "radio" in lieu of "wireless."

The U.S. Navy began experimenting with the use of radio in submarines. Communications were established off Newport, R.I., at a distance of 4 miles.

The Institute of Radio Engineers was formed by combining the Society of Wireless Telegraph Engineers and the Wireless Institute. Robert H. Marriott, a civilian radio expert in the employ of the Navy, was its first presiding officer. (13 May)

The Third International Radio Conference convened in London. The American delegation was headed by Rear Adm. John R. Edwards, USN. Other naval members were Lt. Comdr. D. W. Todd, USN, and Dr. L. W. Austin. (4 June)

The temporary naval radio station, Kodiak, Alaska, was struck by lightning and destroyed.

Construction was commenced on the naval radio station, Radio (Arlington), Virginia.

The United Wireless Telegraph Co. was adjudged guilty of infringing Marconi patents. As a result, a bankruptcy petition was filed. Their assets, which included 400 ship installations and 17 shore radio stations, were acquired by Marconi interests.

The Office of Superintendent of Naval Radio Service was established under the Chief of the Bureau of Navigation for the purpose of operating and administrating Government radio stations. Material and budgetary functions remained the responsibility of the Bureau of Steam Engineering. Capt. (later Rear Adm.) W. H. G. Bullard, USN, was assigned duty as the first superintendent.

The Third International Radio Conference adopted a Convention which included regulations pertaining to safety of life at sea, most of which had been proposed by the U.S. delegation. (5 July)

The U.S. Government extended an invitation to hold the Fourth International Radio Conference in Washington in 1917.

Naval radio stations were opened to commercial traffic in all areas where commercial radio facilities were nonexistent or inadequate.

Naval radio stations were modernized. The Wireless Apparatus Co.'s IP76 double-banked receivers, using Pickard's perikon detectors, were provided.

R. A. Fessenden joined the staff of the Submarine Signal Co.

The Radio Ship Act of 1910 was amended to require certain seagoing vessels to carry two operators, to install an adequate source of auxilliary power for radio equipment, and to extend its provisions to cover shipping on the Great Lakes.

The Alaskan radio expedition of 1912, under command of Lt. E. H. Dodd, USN, established naval radio stations at Unalaga, St. George, Kodiak, and Cordova, and refitted the stations at St. Paul and Dutch Harbor.

The Bourne bill was introduced in the Senate to provide legislation necessary for the Government to control the activities of commercial and amateur radio stations.

S. 5334, a substitute for the Bourne bill, which reduced governmental authority and defined the

controls over commercial and amateur stations was introduced. This bill was supported by Government officials, with Lt. Comdr. (later Rear Adm.) D. W. Todd, USN, as their spokesman, and was perfunctorily opposed by commercial and amateur interests.

The Navy experimented with radio in aircraft, under the direction of Ens. (later Capt.) C. H. Maddox, USN, and succeeded in establishing communication, from a height of 300 feet, with the U.S.S. *Stringham* over a distance of 6,000 yards. The same aircraft also made contact with the U.S.S. *Bailey* and the naval radio station, Annapolis, Md.

Congress passed S. 5334 and it became Public Law 264. (13 Aug.)

Lt. (later Rear Adm.) Stanford C. Hooper, USN, was assigned duty on the staff of the Commander in Chief, U.S. Atlantic Fleet as Fleet Radio Officer. This was the first time that an officer had been designated specifically to advise a fleet commander on matters pertaining to radio. (16 Aug.)

Congress appropriated funds for the erection of high-powered naval radio stations in the Canal Zone, on the west coast, in the Hawaiian Islands, American Samoa, Guam, and the Phillippines.

All battleships, flagships of cruiser and gunboat divisions, and destroyer flotilla leaders were directed to appoint radio officers.

Hooper succeeded in firmly establishing discipline and exercising control of radio circuits of the Atlantic Fleet.

The Fessenden 100-kw. synchronous rotary spark transmitter was installed at the U.S. Naval Radio Station, Radio (Arlington), Virginia. (Dec.)

The Federal Telegraph Co. installed a Poulsen 30-kw. arc transmitter at the U.S. Naval Radio Station, Radio (Arlington), Virginia, for comparative tests with the Fessenden 100-kw. synchronous rotary-gap spark transmitter.

Radio competition was established between ships of the U.S. Atlantic Fleet.

Public Law 264 became effective. (13 Dec.)

The Tropical Radio Co., subsidiary of the United Fruit Co., purchased the controlling interest in the Wireless Specialty Apparatus Co.

De Forest and several of the officers of the defunct Radio Telephone Co. were charged with using the mails to defraud, and were tried by the Federal Government. De Forest was acquitted.

De Forest discovered that increased signal amplification could be obtained by connecting three-element tubes in cascade.

John Hays Hammond, Jr., developed an automatic course stabilization device and a means of security of its control by radio.

The Commander in Chief, U.S. Atlantic Fleet, issued to his command a scouting cipher of the transposition type.

George Clark and Guy Hill, U.S. Navy civilian radio experts, developed a quick frequency changer for radio transmitters.

Tests conducted with the 30-kw. Poulsen arc transmitter indicated the possibility of its being superior to the 100-kw. synchronous rotary-spark transmitter.

1913

The continued failure of radio equipment manufacturers to meet Navy specifications for ruggedness and reliability resulted in a Bureau of Steam Engineering decision to design and manufacture its own radio equipment.

The Navy obtained rights to the Cohen capacity coupled receiver circuit and employed Dr. Louis Cohen as a consultant in receiver design. Additional radio engineers were employed, and the various navy yards were made responsible for the design and manufacture of specific components. (Feb.)

The U.S. Naval Radio Station, Radio (Arlington), Virginia, was commissioned. (13 Feb.)

Lt. Comdr. (later Adm.) A. J. Hepburn, USN, relieved Lt. Comdr. D. W. Todd, USN, as Head of the Radio Division.

Lee DeForest formed the Radio Telephone & Telegraph Co.

The United States and France cooperated using radio stations at Radio (Arlington), Virginia, and Eiffel Tower, Paris, to make longitude determinations and to procure data for comparing velocity of electromagnetic and light waves.

The Navy Department issued the confidential registered "Battle Signal Book" of the U.S. Navy, 1913, which followed the same format as the "General Signal Book, U.S. Navy, 1908."

Acceptance tests of the Fessenden 100-kw. synchronous rotary-spark transmitter conducted between the U.S.S. *Salem* and U.S. Naval Radio Station, Radio (Arlington), Virginia, proved the superiority of the 30-kw. Poulsen arc transmitter and Fessenden's heterodyne method of reception. The Fessenden 100-kw. transmitter failed to meet contract guarantees. (May)

De Forest discovered that the three-element tube could be used as an oscillator.

Sound equipment was installed, in one division of battleships of the Navy for experimental signaling purposes. Perfect signaling was carried on by this method with the division at anchor. When the method was tested with the division underway, the ship generated noises which interfered to the extent that further tests were abandoned.

The Bureau of Steam Engineering stated its policy concerning radio patents, ". . . . it could not take cognizance of patents. It must have certain apparatus and must go on buying it from whomever can or will supply it until it is informed by the Department of justice or some other authority that we must stop it." However, Navy contracts for radio equipment continued to carry a clause requiring supplying firms to protect the Government against patent infringement actions. (20 May)

Difficulty in communicating with U.S. Atlantic Fleet units off Veracruz, Mexico, pointed out the inadequacy of the naval radio system from a military standpoint and the lack of security of transmitted information.

A revision to the 1913 "Battle Signal Book" was issued which provided for enciphering code groups.

Edwin H. Armstrong filed patent application on the regenerative circuit. (29 Oct.)

Radio received major consideration at the Safety at Sea Conference held in London. (12 Nov.)

Ten three-element vacuum tube amplifiers were purchased by the U.S. Navy from the DeForest Radio Telephone & Telegraph Co.

The U.S. Navy accepted the 100-kw. Fessenden transmitter, settlement being effected by compromise.

Bellini-Tosi direction finder equipment was installed and tested in the U.S.S. *Wyoming* with disappointing results. It was removed and installed at Cape Cod, Mass. for further tests ashore.

1914

The Service Radio Code of the U.S. Navy was promulgated for the use of radio operators. It was not intended as a security system but was used as such during the Veracruz incident. (10 Feb.)

De Forest filed application for a U.S. patent on a feedback circuit similar to one filed by Armstrong months earlier. (Mar.)

De Forest exhibited a radio receiver developed by him which utilized a three-element vacuum tube as an oscillator. This could be used to provide the locally generated continuous waves required for heterodyne receiving. (Apr.)

The Naval Radio Station, Darien, C.Z., fitted with a 100-kw. arc transmitter, was commissioned. This was the first station of the high-powered chain. (1 July)

German men-of-war off Veracruz, notified of England's entrance into World War I by an apparently innocuous commercial message, managed to put to sea before the British commander became aware of the situation. (2 Aug.)

President Wilson issued a proclamation which prohibited the handling of messages on nonneutral character by radio stations within the jurisdiction of the United States. The Secretary of the Navy was made responsible for its enforcement, and he delegated this responsibility to the Superintendent of the Naval Radio Service. (5 Aug.)

The Marconi Wireless Telegraph Co. of America questioned the validity of censorship instructions placed into effect by the Navy. (12 Aug.)

The Marconi Wireless Telegraph Co. of America radio station at Siasconsett, Mass.,ignored censorship and rendered nonneutral service to a British cruiser. The station was closed by the Navy. (Sept.)

Hooper was ordered to Europe as an observer of radio usage in the war zone.

The high-powered radio station at Tuckerton, N.J., ownership of which was disputed between belligerent nationals, was taken over and operated by the Navy, at the direction of the President. (9 Sept.)

The Navy tested the Hammond system of remote radio control of moving objects.

A 30-kw. arc transmitter was installed at the radio station operated by the Navy at Tuckerton, N.J.

The Secretary of the Navy convened a board to review naval communications requirements and to make recommendations to bring the Naval Radio Service up to a satisfactory state-of-war readiness. (6 Dec.)

The Radio Test Shop, Washington Navy Yard, was charged with the task of originating means of and developing apparatus for radio reception.

The Radio Test Shop, Washington Navy Yard, redesigned the De Forest audiofrequency amplifiers and began manufacture of two-stage amplifiers, designated SE 1000.

R. A. Fessenden of the Submarine Signal Co. developed an underwater oscillator which served both as a transmitter and receiver. He patented the method in the belief that signals emitted by the oscillator and reflected by submerged objects could be used to measure distance.

The first cross-licensing agreement of U.S. radio patents was consummated between Marconi interests and the National Electric Signaling Co. The Marconi interests paid the latter almost $300,000 in royalties for previous infringements. This reflected their failure to maintain adequate research and to maintain their equipments up to date.

The Radio Telephone & Telegraph Co. (De Forest) sold radio rights to the three-element tube to the American Telephone & Telegraph Co. for $90,000. De Forest retained limited rights to manufacture tubes for amateur and experimental purposes. Arnold and Langmuir completed its development and application as a repeater for longdistance telephony.

1915

Hooper completed his duty as radio observer in Europe and returned to the United States under orders as the Head of the Radio Division, Bureau of Steam Engineering.

Mr. Hiram Percy Maxim organized the amateur radio association, the American Radio Relay League. (Jan.)

Congress authorized an additional half million dollars for the construction of high-powered naval radio stations. (3 Mar.)

Hooper became Head of the Radio Division, Bureau of Steam Engineering. (Apr.)

The British Marconi Co. opened negotiations with the General Electric Co. for the exclusive use of

the Alexanderson alternator. These negotiations failed because of the wartime pressure on British foreign exchange. (May)

The American Telephone & Telegraph Co. began tests of long-distance radio voice communications from Radio (Arlington), Virginia, with the cooperation of the Naval Radio Service. (15 June)

The Navy obtained the American Telephone & Telegraph Co.'s method of providing a feedback circuit to make an associated vacuum tube oscillate. This method was incorporated in receivers being designed at the Washington Navy Yard.

Navy receivers, Types A (60-600 kc.), B (30-300 kc., and C (1200-3000 kc.) were designed by Dr. Louis Cohen with the assistance of Messrs. George C. Clark and L. C. Butts and placed in production at the Washington Navy Yard.

The German-owned and unlicensed station at Sayville, Long Island, suspected of rendering nonneutral service, was taken over by the Navy for the purpose of providing an additional transatlantic radio circuit. (9 July)

Voice communications transmitted by the American Telephone & Telegraph Co. from Radio (Arlington), Virginia, were received at Darien, C.Z., Mare Island, Honolulu and Paris. (Oct.)

The Marconi Wireless Telegraph Co. of America sought an injunction against Emil J. Simon to prevent his use of the Marconi four-circuit tuning patent in equipment sold by him to the Navy. Simon contended that the Government was liable under the act of 5 June 1910. His contention was upheld.

The Naval Consulting Board of the United States was organized under the chairmanship of Mr. Thomas Alva Edison. (2 Oct.)

The U.S. States Department refused to assist the American Marconi Wireless Telegraph Co. in their efforts to obtain concessions from South American countries for the purpose of extending radio communications to those countries. (4 Nov.)

Navy Type A 1917, receiver was designed by the Radio Test Shop, Washington Navy Yard.

Dr. Peter Cooper Hewitt and Mr. Elmer A. Sperry commenced developing a gyro-stabilization system for pilotless flying bombs. The cost of this development became excessive, and upon their request the Naval Consulting Board of the United States gave the project favorable consideration.

The Navy commenced broadcasting hydrographic and meteorological bulletins, covering west coast waters, from U.S. Naval Radio Station, Mare Island, Calif.

Thirty kw. arc transmitters were installed at naval radio stations at Boston, Mass.; Guantanamo Bay, Cuba; Great Lakes, Ill.; San Juan, P.R.; and Cordova, Alaska.

Congress established the Chief of Naval Operations as the senior military command over all Navy activities. Cognizance of the operations of the Naval Radio Service was transferred from the Bureau of Navigation to the Chief of Naval Operations. Maintenance and budgetary responsibility remained with the Chief of the Bureau of Steam Engineering.

Dr. F. A. Kolster of the Bureau of Standards developed a rotating coil direction finder.

1916

The Superintendent of Naval Radio Service took the initial step in organizing the U.S. Naval Communication Reserve. Members of the American Radio Relay League and commercial operators formed the nucleus of this organization.

Two sets of Bellini-Tosi radio direction finder equipment were purchased under guarantee from the Marconi Wireless Telegraph Co. of America. The tests were unsatisfactory and the equipments were returned to the contractor.

Mr. William Dubilier submitted mica condensers to the Navy for test. These proved unsatisfactory but resulted in the Navy drawing up specifications for a condenser of this type. Dubilier was successful in

meeting these specifications.

The Navy began using the world's first remote radio receiving and transmitter control station, in the old State, War, and Navy Building, Washington.

The U.S. Naval Radio Station, Chollas Heights (San Diego), Calif., equipped with a 200-kw. arc transmitter, was commissioned. (1 May)

A 48-hour mobilization of U.S. communications began, with the cooperation of the American Telephone & Telegraph Co. Using combined radio and landlines the Captain of the U.S.S. *New Hampshire*, off the Virginia Capes, conducted two-way conversations with the Secretary of the Navy in Washington and the Commandant of the Navy Yard at Mare Island, Calif. (6 May)

The Navy purchased two experimental radiotelephone equipments from the Western Electric Co. for installation in battleships. They provided satisfactory two-way telephone communications up to the distances of 30 miles, but were deemed undesirable because they utilized the same frequencies as regular radio communication.

The Navy secured exclusive rights to the Kolster radio direction finder patents for a period of 2 years.

The British radio direction finder network detected the sortie of the German Fleet from Wilhelmshaven to the North Sea. This enabled the British Grand Fleet to meet and engage them at the Battle of Jutland. (30 May)

The Fortifications Appropriation Bill provided funds for tests of and for the exclusive procurement of the Hammond system of remote radio control.

U.S. Naval General Order 236 directed the establishment of the Naval Communication Service headed by a director under the Chief of Naval Operations. Capt. (later Rear Adm.) W. H. G. Bullard, USN, was the first director. (28 July)

The League Island Navy Yard, Philadelphia, Pa., was directed to manufacture 30 direction finders of the Kolster type and to conduct experiments for developing this apparatus for fitting into aircraft.

The Naval Aircraft Radio Laboratory was established at Pensacola, Fla., for the purpose of testing, developing, and fitting aircraft radio equipment.

A joint Army-Navy Board was established to supervise the tests of the Hammond system of radio control. The Navy members were Capt. John A. Hoogerwerff, Comdr. David W. Todd, and Lt. Joseph Ogan, USN. (25 Aug.)

The U.S. Navy in cooperation with the French Government completed the determination of the difference in longitude between Paris and Washington by radio. Measured in terms of time, with a probable accuracy within 0.01 second, this was 5 hours, 17 minutes and 35.67 seconds.

Lt. T. S. Wilkinson, USN, witnessed tests of an aircraft controlled by a Sperry stabilization and course-keeping system. His report stated that the aircraft could not be controlled with the degree of accuracy required to hit a moving target and recommended that the Army might find it useful against military targets.

Decision was rendered that both Marconi and De Forest interests infringed each other in the manufacture of three-element tubes.

U.S. Navy commissioned its new high-powered radio station at Pearl Harbor, Territory of Hawaii. This station was equipped with a 300-kw, arc transmitter. (1 Oct.)

Navy Type B, 1917 receiver was designed.

Congress appropriated funds for the construction of the Naval Research Laboratory.

Transpacific commercial radio circuit was opened to traffic. (5 Nov.)

De Forest experimental station was opened at Highbridge, N.Y., and broadcasted election bulletins which were received within a radius of 200 miles.

Station at New Rochelle, N.Y. operated by Messrs. Charles V. Logwood and George C. Cannon commenced broadcasting music one hour daily, except Sunday. (Nov.)

U.S. Department of Commerce held informal hearings on an Interdepartmental Radio Committee

draft of legislation which materially increased, governmental control over radio. It was opposed by the Marconi interests. (21 Nov.)

The Navy installed a 60-kw. arc transmitter at Radio (Arlington), Virginia, which had been removed from the Tuckerton radio station.

Personnel of the Radio Division, Bureau of Steam Engineering, investigated the underground antenna system of Dr. J. H. Rogers, and noted the increase in the ratio between signal and noise and the better directivity of the system.

U.S. Navy commissioned its new high-powered radio station at Cavite, P.I. It was equipped with a 300-kw. arc transmitter. This completed the construction of the high-powered chain. (19 Dec.)

Secretary of the Navy, Josephus Daniels, openly advocated the elimination of commercial interests from ship-shore radio operations.

Twelve radio direction finder equipments were placed under construction for installation along the Atlantic seaboard.

Navy receivers, Types A, B, and C were installed in ships and shore radio stations.

The Navy began standardization of radio components by assignment of type numbers.

1917

Hearings on proposed Interdepartmental radio legislation, which had been introduced in the House by Congressman Alexander, began before the House Committee on Merchant Marine and Fisheries.

Three sets of reliable radiotelephone equipment, employing frequencies above those normally used for naval radio communications and capable of providing nine simultaneous voice channels, were purchased from the Western Electric Co. and installed in battleships.

Class 4, U.S. Naval Reserve was created. This was the official beginning of the U.S. Naval Communications Reserve.

The Bureau of Steam Engineering contracted with the Western Electric Co. for 15 sets of radiotelephone transceivers for experimental purpose in connection with the submarine chaser program. This equipment was assigned the Navy type number CW 936 and was the forerunner of the modern vacuum tube transmitter.

Lt. A. Hoyt Taylor, USNR, district communication officer, Ninth Naval District, was directed to establish a temporary laboratory and conduct investigations of submerged antenna systems. From these it was determined that antennas submerged in fresh water gave signals 10 times stronger than those of the same type laid underground; that these submerged antenna were periodic and could be utilized for multiple reception; and that an antenna of length equal to one-eighth of a wavelength gave the best response.

The Naval Consulting Board of the United States established a Special Problems Committee. Because of the German submarine menace a sub-committee of this Committee was established to conduct research on submarine detection by sound.

The Submarine Signal Co. proffered its complete facilities to assist the Navy in the development of submarine sound detection systems. This offer was accepted. (28 Feb.)

A comprehensive system of landlines connecting local activities with Naval District Headquarters and connecting the latter with the Navy Department was leased, to make available more frequencies for mobile and transatlantic uses and to reduce interference with those uses.

The General Electric Co. and the Western Electric Co. agreed to work with the Submarine Signal Co. in the development of submarine sound detection systems. The latter company agreed to make a study of the disturbances given off by submarines and other disturbances of a similar nature which might be encountered.

Navy types SE 95 (300-3000 kc.) and SE 143 (100-100 kc.) receivers were designed under the direction of Lt. W. A. Eaton, USN, with the consultant services of Prof. L. A. Hazeltine, developer of the neutrodyne method of radio reception.

At this time over 25 percent of the radio equipment of the U.S. Navy was of naval design. (1 Apr.)

An underwater sound experimental station staffed by personnel of the Submarine Signal Co., the General Electric Co., and the Western Electric Co. was established at Nahant, Mass.

Shortly after 1 p.m., simultaneously with the President's signing the resolution declaring the existence of a state of war with Germany, the U.S. Naval Communication System broadcasted to the world that the United States had entered World War I. (6 Apr.)

All amateur and commercial radio stations were either closed or taken over by the Navy. (7 Apr.)

An Alexanderson 50-kw. alternator was installed in the former Marconi stations at New Brunswick, N.J. The original purpose of this installation was to compare it with the Marconi timed-spark transmitter.

Three-element vacuum tubes manufactured by De Forest Co. were so inferior in quality that about 90 per cent of an order for 2,000 were rejected.

The Secretary of the Navy, Josephus Daniels, appointed a board of naval officers for the purpose of procuring suitable apparatus for conducting both offensive and defensive operations against submarines. This board, known as the Special Board on Antisubmarine Devices, was provided with the services of several consultants experienced in underwater sound. (11 May)

The Secretary of the Navy approved the recommendation of the Naval Consulting Board of the United States, which recommended that the Navy conduct experimental work on automatically controlled aircraft, carrying explosives, capable of being catapulted, and thereafter controlled by radio from the ground or a remotely flying airplane. (22 May)

Dr. L. W. Austin, Director, Naval Radio Research Laboratory, devised an antenna system which made it possible to obtain unidirectional bearings with a radio direction finder.

Prewar differences in operating missions resulted in the U.S. and Royal Navies having incompatible radio equipments. The Royal Navy had highly selective but insensitive receivers, while the U.S. Navy receivers were the exact opposite. This necessitated the installation of British equipment in many U.S. men-of-war operating with the British Grand Fleet.

Lack of security consciousness and failure to develop satisfactory codes and ciphers made it necessary for the U.S. Navy to adopt Allied (British) security systems during the war.

The National Research Council convened a meeting of Allied scientists for the purpose of discussing all previously developed means of detection of underwater sounds. (1 June)

The Special Board on Antisubmarine Devices was organized, and plans were drawn up for the coordination of all activities concerning underwater sound detection. Acting upon a recommendation of the National Research Council, additional groups of scientists were formed, each group being assigned research in specified areas of underwater sound detection.

The NCB, Mark I cipher box, designed by Lt. Comdr. (later Rear Adm.) Russel Wilson, USN, was issued to the naval service.

The Pan-American Radio Co. was formed by the British and American Marconi companies and the Federal Telegraph Co. for the purpose of exploiting radio communications in South American countries.

Comdr. B. B. McCormick, USN, reported as Naval Inspector of Ordnance at the plant of the Sperry Gyroscope Co., to provide naval supervision over a contract with that company to develop naval seaplanes into pilotless missiles. (15 June)

Lt. Comdr. H. P. LeClair, USN, became Head of the Radio Division, Bureau of Steam Engineering.

Messrs. Given and Walker organized the International Signal Co., to which they transferred the patent assets of the National Electric Signaling Co.

Prof. M. Mason proposed the development of the MV-tube underwater sound detection equipment.
The Director of Naval Communications was assigned additional duty as Chief Cable Censor. (26 July)

Schools for the training of radiomen were established at Harvard University, Cambridge, Mass., and Navy Yard, Mare Island, Calif. The two schools had a combined capacity for training 5,000 men.

The Allied Transatlantic Communication Conference held in New London, Conn., decided to augment radio communications between the United States and Europe by constructing two additional high-powered stations in the United States and one in France.

The New London group of scientists which had been conducting research in binaural methods of submarine sound detection, was augmented and redesignated the Naval Experimental Station. This station was assigned the additional function of service testing all development of underwater sound detection equipment.

The Navy Department requested the General Electric Co. to provide a higher powered alternator for the transmitting station at New Brunswick, N.J. They replied that a 200-kw. alternator would be available by 1 January 1918. (1 Oct.)

Lt. A. Hoyt Taylor was assigned duty as Transatlantic Communication Officer in command of the reactivated former Marconi receiving station at Belmar, N.J. He was directed to utilize the information gained by his underwater underground experiments to improve the efficiency of transatlantic reception.

Lt. E. H. Loftin, District Communication Officer, Eighth Naval District, was directed to utilize the knowledge obtained by Taylor for the purpose of duplexing the Naval Radio Station, New Orleans, La., without locating the transmitters remote from receiving equipment.

The Code and Signal Section became a branch of the Naval Communications System. (Dec.)

Numerous acoustical devices were developed for underwater sound detection, none of which were too reliable. All required either to be towed or to have the detecting vessel stop in order to listen. However, most of the U.S. Navy destroyers and submarine chasers were equipped with listening equipment, mostly of the MV-tube type.

1918

Naval Aircraft Laboratory was moved from Pensacola, Fla., to the Naval Air Station, Hampton Roads, Va. (1 Jan.)

President Wilson's Fourteen Points were broadcast by the New Brunswick, N.J., station and were received at the German station at Nauen. (8 Jan.)

The Director Naval Communications was made responsible for the collection and dissemination of information about movements of ships. (10 Jan.)

The Navy purchased the German-owned radio patents seized by the Alien Enemy Property Custodian.

The Marconi Wireless Telegraph Co. of America advised the Navy Department of the plans of the Pan-American Radio Co. for developing radio communications in South American countries. Assurances were given by the Head of the Radio Division, Bureau of Steam Engineering, that the Secretary of the Navy understood and would not interfere with the proposed plans.

The Bureau of Yards and Docks was assigned the responsibility of providing and maintaining local telephone facilities with naval yards and stations, and for providing lines and facilities for connecting them to the nearest commercial exchange. The Naval Communications Service was made responsible for provision of long lines and the operation and administration of all telephone facilities.

The U.S. Supreme Court reversed a decision of September 1915, which had held the Government liable for patent infringement of equipment purchased by it. (4 Mar.)

The first successful flight of a pilotless aircraft was achieved. It was launched by the impulse-type catapult, after which it climbed steadily and flew in a straight line for 1,000 yards, at which distance the automatic distance gear was set to cut the throttle.

Assistant Secretary of the Navy, Franklin D. Roosevelt, issued the so-called "Farragut Letter," accepting certain responsibilities on the part of the Government for the protection of contractors against patent infringement suits. (29 Mar.)

The amateur station of Ens. (later Lt.) A. Fabbri, USNR, at Bar Harbor, Mane, was leased by the Navy for use as a transatlantic receiver station. Because of its location it proved the most efficient station for this purpose. It was equipped with a "blind-end" loop antenna system designed by Mr. E. A. Proctor of the Wireless Specialty Apparatus Co.

The Navy acquired the patents of the Federal Telegraph Co. and their three high-power and five coastal radio stations for $1,600,000 (15 May)

Mr. Carl L. Norden was directed to construct two flywheel-powered catapults for the purpose of launching pilotless flying missiles.

Construction of the Lafayette transmitter station at Croix dé Hins, France, was commenced by the U.S. Navy. (28 May)

Sites were selected for installation of radio direction finder stations at the entrances to the principal U.S. Atlantic seaports.

The Navy installed the General Electric 200-kw. Alexanderson alternator at the Naval Radio Station, New Brunswick, N.J., making it the world's most powerful transmitting station. (June)

Two transatlantic cables were severed by the Germans 60 miles east of Sandy Hook, N.J. (4 June)

A 200-kw. arc transmitter was placed in service at the transmitting station at Sayville, Long Island.

Congress enacted legislation, clarifying the act of 25 June 1910, making the Government responsible to patent owners in the event it manufactured or procured equipment infringing patents. (1 July)

After completing arrangements with several South American countries, the Pan-American Co. discovered that the Secretary of the Navy was determined to use a naval radio station at the U.S. terminal of South American radio circuits. No further effort was made at the time by that company to establish these circuits.

Receiving of transatlantic circuits was centered at Bar Harbor, Maine, from where traffic was automatically relayed to Washington where the messages were copied. All transmitters on transatlantic circuits were keyed from Washington beginning at this time.

A site was selected at Monroe, N.C., for a high-powered transmitting station.

Cmdr. S. C. Hooper, USN, became Head of the Radio and Sound Division, Bureau of Steam Engineering. (Aug.)

Dr. L. W. Austin, Director of the Naval Radio Research Laboratory, developed several balanced circuits, one of which could be used for the simultaneous reception of signals from several different transmitting stations provided they used separated frequencies.

The Hammond system of radio control was demonstrated in Hampton Roads, Va. In these demonstrations the steering functions, the engines, and mine-setting operations of a moving surface vessel were controlled from a shore station and from an aeroplane. (23 Aug.)

A hydrophone school was established at New London, Conn., to train officers in the installation and maintenance of underwater sound detection equipment.

Lt. Comdr. A. Hoyt Taylor became the Director of the Naval Aircraft Radio Laboratory. (Sept.)

The Naval Radio Station, Annapolis, Md., was commissioned. It was equipped with a 300-kw. arc transmitter. (Sept.)

President Wilson's address launching the Fourth Liberty Loan campaign was broadcast from New Brunswick, N.J., and receipted for by the German station at Nauen. (17 Sept.)

A successful launching of a pilotless aircraft was made but lack of ruggedness and instability of the

plane caused it to crash. (23 Sept.)

The German Government transmitted from Nauen, addressed to the Director, Naval Communications, its acceptance of Allied terms for an armistice. This was received in Washington and immediately delivered to the White House. (12 Oct.)

The successful launching of a pilotless aircraft was followed by sustained flight at 4,000 feet about two degrees off the preset course. The distance mechanism, set for about 7 miles, failed to function and the plane flew out of sight to the eastward over the Atlantic. (17 Oct.)

Norden recommended better designed planes, and a redesigning of the automatic control system to permit carry a human check pilot during further development of pilotless aircraft.

The Naval Aircraft Radio Laboratory was moved from Hampton Roads, Va., to the Naval Air Station, Anacostia, D.C.

The joint board reporting on the Hammond tests on 23 August stated that he had not demonstrated control of a submerged carrier (torpedo).

A contract was signed for two 1,000-kw. transmitters to be installed in the transmitting station at Monroe, N.C. (1 Nov.)

The Navy purchased all shipboard and shore station installations of the Marconi Wireless Telegraph Co. of America for the U.S. Government except those used for transoceanic communications.

An armistice was signed with the German Government. (11 Nov.)

The construction of the Lafayette transmitting station was halted. (1 Dec.)

The proposal to construct a high-powered transmitting station at Monroe, N.C., was abandoned.

Representative Alexander introduced a resolution in Congress which proposed giving the Navy Department exclusive ownership of all present and future commercial radio stations in the United States.

Three radio direction finder stations were established around the entrance to New York Harbor and began coordinated operations to provide fixes for vessels in that vicinity. (26 Dec.)

The Navy experimented with low-frequency underwater reception and discovered that a submarine could receive high-powered transmissions over long distances when submerged to a depth of 21 feet.

The first air navigation range system was installed by the Navy.

With the exception of the Navy Experimental Station, New London, Conn., all the underwater sound detection groups and training schools established during the war were abolished. Dr. H. C. Hayes became the head of the remaining activity which was considerably decreased in size and limited in functions.

1919

The vigorous opposition of commercial interests resulting in the House Merchant Marine Committee unanimously tabling the Alexander Resolution. See 1917.

The Radio Test Shop designed the SE 1420 (40-1250 kc.) receiver. This was thoroughly shielded and was the first radio receiver built with an amplifier as an integral part of the set.

Reception of transatlantic signals were sufficiently reliable to permit closing the Belmar, N.J. receiver station.

The Marconi interests renewed their efforts to procure exclusive use of the Alexanderson alternator. This was opposed by the Navy and Comdr. S. C. Hooper, USN, was successful in delaying the consummation of this transaction. (2 Feb.)

The Fortification Appropriation Act provided funds for further demonstrations and possible purchase of the Hammond system of remote radio control torpedoes or other underwater carriers of high explosives. (3 Mar.)

Rear Adm. W. H. G. Bullard, USN, again became Director of Naval Communications. (31 Mar.)

Dr. H. C. Hayes discovered that the MV-tube set could be used for measuring the angle of reflection of transmitted signals echoed from the ocean floor. This permitted its use as a depth finder.

A conference between General Electric Co. officials Bullard and Hooper, resulted in the decision by the former to discontinue negotiation with the Marconi interests for the sale of Alexanderson alternators. (18 Apr.)

General Electric Co. officials reached the decision to establish an international communication system, provided the support of the U.S. Government could be obtained to provided them a monopoly in this field. Navy officials agreed to endeavor to obtain the desired support and aided in drafting a proposed charter for the new company.

The Secretary of the Navy directed that action on the proposed charter giving the General Electric Co. a monopoly of radio communications in the United States be held in abeyance.

Construction of the Lafayette transmitting station was resumed. (4 May)

Owen D Young suggested that the officials of the Marconi Wireless Telegraph Co. of America and the Pan-American Radio Co. join with the General Electric Co. in forming an American-controlled radio operating company.

A flight of three U.S. Navy NC planes departed Trepassey, Newfoundland, on a transatlantic flight. They were fitted with radio equipment especially configured to the planes. (16 May)

The Navy plane NC-4 arrived at Horta, Fayal, Azores. The other planes made forced landings short of the Azores; one sank, and another made Ponta Delgado but proceeded no further. Radio communications were maintained with U.S. Naval radio stations or with ships stationed along the path of the flight for the entire trip. (17 May)

The NC-4, arrived at Lisbon, Portugal. Lt. Comdr. A. C. Reed, USN, completing the first Atlantic crossing by an airplane. Due to compass casualty the flight from the Azores to Portugal was made possible only by homing on the destroyers stationed along the plane's path with the direction finder. Ens. H. C. Rodd, USNR, acted as radio operator of the NC-4. (27 May)

The pilotless aircraft missile program was moved to the Naval Proving Ground, Dahlgren, Va., under the supervision of Capt. T. T. Craven, USN, with Mr. Carl L. Norden as consultant. (27 May)

The Secretary of the Navy deferred decision to enlist Government aid in support of an American controlled radio operating company.

General Electric Co. officials reached the decision to form an American operating company, free of foreign control, with or without obtaining a Government monopoly.

The sole remaining supporter of Government ownership of United States radio stations was Secretary of the Navy Josephus Daniels. (1 July)

During fiscal year 1919, the U.S. Naval Communication System, exclusive of fleet communications, handled 1,189,120 dispatches containing text amounting to 71,347,860 groups.

The first Presidential radio broadcast was made by President Wilson returning from France in the U.S.S. *George Washington*. His address to the crew was indistinctly received on the northeastern seaboard on 2380 kc. (4 July)

The President, by Executive order, directed the Navy to return commercially owned radio stations as of midnight, 29 February 1920. (1 July)

The Secretary of the Navy transmitted to Congress the text of a proposed bill which would authorize the Navy to use its stations for commercial traffic.

The Secretary of the Navy transmitted a proposal to Congress recommending that ship-shore and transocean radio circuits be made a Government monopoly under the Navy and that all naval radio stations be opened to commercial and press traffic.

Mr. E. J. Nally of the Marconi Wireless Telegraph Co. of America and Mr. A. G. Davis of the General Electric Co. were sent to England to purchase British-owned interests in the Marconi Wireless

Telegraph Co. of America.

The U.S.S. *Ohio* was assigned to the Bureau of Engineering as an experimental ship for the development of new radio equipments and installations.

The General Electric Co. obtained the controlling interest in the Marconi Wireless Telegraph Co. of America by the purchase of 364,826 shares of stock.

The Navy laid a radio-piloting cable in Ambrose Channel at the entrance to New York Harbor.

The U.S.S. *Semmes* conducted tests of the radiopiloting cable laid in Ambrose Channel. It was demonstrated that such a system could be used to permit navigation in restricted waters during periods of low visibility. Following the tests the project was turned over to the Department of Commerce, which took no further action. (6-9 Oct.)

The Radio Corp. of America was incorporated. The articles of incorporation prohibited the election of a director or officer who was not a citizen of the United States and allowed such participation by the Government in the administration of its affairs as the directors might deem advisable. Not more than 20 percent of the stock could be owned and voted by aliens. Mr. Owen D Young was elected chairman of the board of directors, Mr. E. J. Nally, president and Mr. David Sarnoff, managing director. (17 Oct.)

Norden recommended the pilotless-aircraft missile project be expanded to include the use of obsolete planes as antiaircraft targets (drones).

The Radio Corp. of America began operations. The Marconi Wireless Telegraph Co. of America ceased operations. (20 Nov.)

The General Electric Co. and the Radio Corp. of America signed a cross-licensing agreement. The latter company was prohibited from manufacturing radio equipment but became the sales agent for General Electric radio equipment. (20 Nov.)

The joint Army-Navy Radio Control Board recommended that the proper naval weapon using the Hammond system of radio control should be a standard naval torpedo with an added midsection to house the radio control equipment.

The Radio Test Shop, Washington Navy Yard, designed the SE 1440 receiver for use with direction finding equipment. It was the first receiver in which the audiofrequency amplifying circuit was an integral part. Following this, the same facility designed multiple-stage amplifiers, consisting of three stages of radiofrequency amplification followed by a detector stage and then two stages of audiofrequency amplification, in order to provide the necessary amplification for aircraft reception and direction finding.

The Bureau of Steam Engineering made the decision to make no further purchase of arc or spark equipments and to concentrate on the development of satisfactory vacuum tube transmitters.

The Navy developed an antenna sleet melting system for installation in its stations in subfreezing areas.

The Navy first established air-to-ground voice communications by radio.

By the end of 1919 the U.S. Navy was equipped with receiving equipment vastly superior to that of other navies or commercial users.

The commercial companies, seeing no future requirements for vacuum tube transmitters, refused to continue their development. Late in the year, the Bureau of Steam Engineering decided to expend a quarter of a million dollars to continue development of this type of transmitter.

A fleet communication plan, entitled "The Force Tune System" was developed and adopted. This required an increase in shipboard radio installations and simultaneous reception and transmission.

1920

The Bureau of Steam Engineering addressed similar letters to the American Telephone & Telegraph Co. and the General Electric Co. requesting they make some arrangement between themselves which

would permit the manufacture and further development of the three-element tube. (5 Jan.)

Following the request of the directors of the Radio Corp. of America that a naval officer above the rank of captain be appointed to attend their meetings to present the Government's views, Rear Adm. W. H. G. Bullard, USN, Director of Naval Communications, was assigned this additional duty by direction of President Wilson. (14 Jan.)

The Bureau of Steam Engineering resorted to temporary improved installations of existing radio receiving equipments which were given the designation models E, F and R. Models E and F included an acceptor-rejector circuit. To reduce interference, the motor buzzer set was adopted as a substitute for the spark gap for low-powered transmissions.

In anticipation of a satisfactory patent cross-licensing agreement between three-element tube manufacturers, and in an effort to standardize and obtain improved tubes at a lower cost, the Bureau of Steam Engineering convened a conference of naval radio engineers and commercial manufacturer's representatives. (30 Jan.)

The U.S.S. *Breckinridge* ran a line of sonic soundings from Charleston, S.C., to Key West, Fla., using the MV-tube equipment and Hayes' angle of reflection method.

Contracts were made with the General Electric Co. for 20 model TC transmitters for battleships and 15 model TD transmitters for naval air stations. Another contract was made with the Western Electric Co. for 20 model TB voice modulated transmitters for installation in battleships for gunfire control communication.

The Navy returned the commercially owned radio stations, taken over at the beginning of the war, to the Radio Corp. of America, which resumed commercial operations of them on the same day. (1 Mar.)

The U.S.S. *Ohio* was assigned the tasks of developing improved and below deck radio installations in ships; improvements in and multiple use of antennas; service tests of new equipments; and development of a remote radio control system for surface ships.

The Westinghouse Electric and Manufacturing Co. purchased a controlling interest in the Fessenden radio patents. (22 May)

The title of the Bureau of Steam Engineering was changed to Bureau of Engineering. (4 June)

Congress authorized the use of naval radio stations for 2 years for the handling of commercial traffic and press on a noncompetitive basis with commercial enterprises.

Armstrong was granted U.S. Patent 1,342,885 on the superheterodyne receiver. (8 June)

A Navy plane was successful in homing on the radio transmissions of a battleship at a distance of 160 miles. (16 June)

The Naval Radio Laboratory, Anacostia, D.C., began scheduled radio broadcasting.

The American Telephone & Telegraph Co. became a corporate partner of the General Electric Co. in ownership of the Radio Corp. of America. The two companies signed a cross-license agreement which made it possible to manufacture and improve the three-element tube. (1 July)

The Westinghouse Electric & Manufacturing Co. and the Navy signed cross-license agreements on radio patents.

The Westinghouse Electric & Manufacturing Co. purchased the Armstrong regenerative and superheterodyne radio patents. (5 Oct.)

The Lafayette transmitting station, equipped with two 1,000 kw. arc transmitters, was completed and turned over to the French Government. (15 Nov.)

The Navy made a successful launching and flight of a pilotless aircraft missile utilizing a special designed plane. (18 Nov.)

Comdr. S. C. Hooper, USN, addressed a letter to Owen D Young, chairman of the board of directors, Radio Corp. of America, pointing out that officials of that company were thwarting efforts of radio manufacturers to provide vacuum tubes to the public. (11 Dec.)

Construction of the Naval Research Laboratory, Anacostia, D.C., was commenced.

The Navy experimented with voice communications by radio between aircraft and a partially submerged submarine and was successful in establishing communications.

1921

The Federal Telegraph Co. negotiated a contract with the Government of China for the erection of transpacific radio stations in that country. (8 Jan.)

The Radio Corp. of America objected to the establishment of a transpacific circuit by the Federal Telegraph Co. and suggested that such a circuit be operated by a consortium of all powers which had wrangled radio concessions from China. Since this was not consistent with our open door policy, Young then suggested that the Radio Corp. own and operate the U.S. terminal and the Federal Co. operate the Chinese terminal.

The Secretary of the Navy approved the recommendations of a board appointed to investigate and report on the feasibility of the remote control of aircraft by radio. This board had recommended that this project should be undertaken and placed under the cognizance of the Bureau of Ordnance.

The Interdepartmental Radio Board convened to adjudicate patent infringement claims against the Government. Navy members were Comdr. S. C. Hooper and Lt. Comdr. E. H. Loftin. The latter was appointed chairman. (12 Feb.)

Loftin in his work with the Interdepartmental Radio Board stated: "There was not a single company among these making radio sets for the Navy which possessed basic patents sufficient to enable them to supply, without infringement, a complete transmitter or receiver."

The Chief of the Bureau of Engineering addressed similar letters to the General Electric and American Telephone & Telegraph Co. criticizing them for failure to provide three-element tubes for the merchant marine. (23 Apr.)

The Chief of the Bureau of Ordnance notified the Chief of Naval Operations of his intention to discontinue efforts to develop a pilotless flying missile. (27 Apr.)

A contract was issued the General Electric Co. for the Model TE transmitter configured for submarines, the Model TF for submarine tenders, and the Model TH for general service usage.

The Interdepartmental Radio Board recommended the U.S. Government make infringement award to patent owners in the amount of $2,869,700.27. $1,819,520.69 of this sum was apportioned against the Navy. (31 May)

The U.S.S. *Iowa* was fitted for remote radio control and the U.S.S. *Ohio* was equipped with remote radio control equipment.

The U.S.S. *Iowa*, under radio control of personnel in the U.S.S. *Ohio*, was used as an aircraft bombing target. Only two direct hits were made by the U.S. Army Air Force and these did little damage. (22 June)

The Westinghouse Electric & Manufacturing Co. became a corporate partner in the Radio Corp. of America with the privilege of manufacturing 40 percent of the radio equipment sold by that corporation. (30 June)

The Radio Corp. of America possessed rights to over 2,000 radio patents, including the most important ones of the period.

The Army discontinued its project for the remote control of torpedoes. The Navy continued the development. (30 July)

The First Annual Convention of the American Radio Relay League opened in Chicago, Ill. (30 Aug.)

In developing radio controlled aircraft (drones) the responsibility for the design, development, and tests of the radio equipment was assigned the Bureau of Engineering. (21 Oct.)

Comdr. S. C. Hooper, USN, advised the Radio Corp. of America of the Government's dissatisfaction

with its policies.

A consortium of American, British, French, and German companies was formed, with U.S. Government approval, to operate circuits between the United States and South American countries.

Young's plan for the cooperation of the Federal Telegraph Co. and the Radio Corp. of America for the provision of radio facilities in China was approved by Secretary of the Navy, Edwin C. Denby, provided the approval of both the Chinese and the U.S. Governments were obtained and that in establishing the circuit with China no tacit approval of a monopoly would be considered to exist.

Young stated he agreed with the first proviso of Denby's letter but that it was impracticable, that he did not understand why the Navy entered the discussion, and ended by stating that he considered a monopoly in radio by the Radio Corp. of America was essential in the interest of American nationals.

The Radio Corp., by this date, operated the U.S. terminals of circuit with England, Japan, Germany, Norway, Austria, France, Poland, and countries of the South American consortium. (31 Dec.)

Twenty-seven amateur radio stations in the United States, transmitting on high frequencies, with power outputs varying between 50 and 1,000 watts were received in Scotland.

Several House resolutions were introduced for the purpose of appropriating funds to carry out the recommendations of the Interdepartmental Radio Board for the payment of infringement damages. Neither of these resolutions was adopted, Congress considering that these matters should be processed through the U.S. Court of Claims.

The Government returned the radio patents purchased from the Federal Telegraph Co. in 1918 but retained a nonexclusive, nontransferable, nonrevokable license to use these and future patents granted the Federal Telegraph Co. or its successors.

The United Fruit Co. became a corporate partner in the Radio Corp. of America.

The Radio Corp. of America refused to enter into a radio patent cross-license agreement with the Navy.

1922

The Bureau of Engineering assigned a project to the Naval Aircraft Radio Laboratory for the design and development of radio equipment for the remote control of aircraft. Mr. C. B. Mirick was designated project engineer. (28 Jan.)

The U.S. Senate ratified the treaties stemming from the Washington Conference on the Limitation of Armaments. This resulted in a sharp reduction in the funds available for research in and procurement of electronic equipments.

A timing device developed under the direction of Dr. H. C. Hayes, Naval Experimental Station, for measuring deep depths by sonic means was tested in the U.S.S. *Ohio* and found to be extremely accurate.

The First National Radio Conference convened in Washington, D.C. (27 Feb.)

A new U.S. naval policy was promulgated which required the maintenance and operation of a communication system based upon a two-ocean war and the development of all forms of fleet communications required for battle efficiency. (29 Mar.)

Radio communications during the winter exercises of 1921-22 were entirely unsatisfactory, and the commanders of both the Atlantic and Pacific Fleets reported a requirement for immediate improvement. Among numerous other difficulties, the Model TC transmitter proved unreliable and unsatisfactory and the use of the force tune system created so much interference that it was impossible to receive messages. Following this, the contract for the Model TG transmitter, which had not been placed in production, was cancelled, and the Bureau of Engineering stated it would make no further procurement of vacuum tube transmitters until such time as improved models became available.

Congress authorized continued use of Naval radio stations for commercial traffic and press, on a noncompetitive basis, until 30 June 1925. (14 Apr.)

Eighty radio broadcasting stations possessed Department of Commerce licenses. It was estimated that there were between 500,000 and 700,000 radio receivers in the United States. Interference between broadcasting stations and naval radio stations was increasing daily and the Navy was subjected to much criticism by the public for disrupting broadcast reception. (1 May)

The Naval Aircraft Radio Laboratory broadcasted President Warren G. Harding's address dedicating the Lincoln Memorial, Washington, D.C.

A new underwater sound system (sonar) utilizing a Fessenden oscillator and MV hydrophones, combined with the accurate timing system developed by H. C. Hayes, was tested in the U.S.S. *Stewart* en route from Newport, R.I., to Chefoo, China, via the Suez Canal. A continuous profile of the ocean's floor was made along the ship's track for the entire voyage.

Owen D Young acknowledged that Comdr. S. C. Hooper, USN, was the motivating force in the establishment of the Radio Corp. of America.

Major E. H. Armstrong announced his superregenerative receiving circuit. (28 June)

The U.S.S. *Ohio* was decommissioned. This necessitated the use of operational ships for service testing radio equipment and materially slowed performance of these functions.

A new organization, which established the U.S. Fleet under a commander in chief, was placed into effect under the command of Adm. Hilliary P. Jones, USN. Lt. T. A. M. Craven, USN, became U.S. Fleet Radio Officer. (1 July)

A total of 198 broadcasting stations had been licensed. The "radio boom" in the United States was in full swing. This increased the requirement for vacuum tube transmitters and resulted in commercial companies increasing their research and development in that field. (1 July)

Thirty-one new broadcasting stations were licensed in the United States during the month of July.

The Radio Corp. agreed, under limited conditions, to provide three-element tubes to competing interests.

Personnel of the Naval Aircraft Radio Laboratory detected a moving object by means of reflected radio waves.

The Federal Telegraph Co. of Delaware was formed by the Radio Corp. of America and the Federal Telegraph Co. of Calif. for the purpose of providing radio communications in China.

Vacuum tubes, with a General Electric Co. rating of 20 kw. were first used in a Radio Corp. of America transmitter at Rocky Point, N.Y. (5 Oct.)

Fleming's U.S. patent on the two-element tube expired. De Forest again began the manufacture of three-element tubes. (7 Nov.)

In 5 months the number of radio broadcasting stations in the United States doubled to a total of 569.

The Navy developed and installed an antenna system capable of transmitting several frequencies simultaneously.

Limited funds prevented further financial support to commercial manufacturers for the development of vacuum tube transmitters and this resulted in naval radio engineers designing vacuum tube transmitters which utilized as many components of the old spark transmitters as possible. The first of the alternating current tube transmitters was the Model TL designed for battleships. This was followed by the Model TM for submarines, the Model TN for shore stations and the Model TO for battleships.

1923

There were approximately 2 million radio receivers in use in the United States. It was estimated that over one hundred million dollars had been spent for radio equipment during the previous 24 months.

The Commander in Chief, U.S. Fleet, reported that rapid communications within the Fleet, between the Fleet and its bases, and between the Fleet and the Navy Department was neither satisfactory nor reliable. (14 Mar.)

The Second National Radio Conference was convened in Washington, D.C. Broadcasting interests, abetted by the public, demanded the Navy relinquish the 500-1500 kc. frequency band. The Interdepartmental Radio Advisory Committee agreed that, as soon as possible, the Navy would use the band only on a noninterference basis. (20 Mar.)

C. Francis Jenkins transmitted photographs by radio from Washington, D.C., to Philadelphia, Pa., with the assistance of naval radio personnel.

A radio control system for pilotless aircraft, designed and developed by Mr. C. B. Mirick of the Naval Aircraft Radio Laboratory, was successfully tested in a piloted F-5-L flying boat. (15 Apr.)

The Radio Corp. of America instituted suit against the A. H. Grebe Co., Inc., in an endeavor to maintain their monopoly of radio tubes. This action resulted in House Resolution 548 which directed the Federal Trade Commission to investigate and report upon the radio industry.

The Navy designed Model TL transmitter, utilizing spark transmitter components, was service tested and found to be satisfactory.

The U.S. Navy General Board concurred with the Commander in Chief. U.S. Fleet, concerning the unreliable and unsatisfactory state of naval communications.

Based upon the recommendations of the Commander in Chief, U.S. Fleet, and the concurrence in these by the General Board and in consonance with the newly promulgated naval policy, the Bureau of Engineering made plans for the modernization of naval radio equipment. Congress was requested to appropriate $2½ million for this purpose.

The Naval Research Laboratory was established at Anacostia, D.C. The Radio Division of this Laboratory consisted of the Naval Radio Research Laboratory, the Naval Aircraft Radio Laboratory, and the Naval Radio Test Shop of the Washington Navy Yard. Dr. A. Hoyt Taylor was the first head of the Radio Division. The Sound Division was formed under Dr. H. C. Hayes by transferring the sound personnel who had been working under his direction at the Naval Experimental Station, Annapolis, Md. (1 July)

The Chinese Government approved the provision of radio communication stations in China by the Federal Telegraph Co. of Delaware. (13 July)

The Mirick designed remote radio control system was installed in an N-9 plane equipped with the Norden automatic control system.

Capt. R. W. McNeely, USN, relieved Comdr. S. C. Hooper, USN, as Head of the Radio and Sound Division, Bureau of Engineering. Hooper was assigned duty as radio officer, staff Commander in Chief, U.S. Fleet. Craven became Head of the ship Section of the Radio Division. (July)

The final remote radio control flight testing for the year was made, with the plane in flight being controlled from the ground for 25 minutes. (14 Nov.)

The Naval Research Laboratory began exploration of use of frequencies above 2000 kcs.

The Naval Research Laboratory designed, constructed, and installed the first airborne high-frequency transmitter in the rigid airship U.S.S. *Shenandoah*.

All battleships were fitted with Model TL transmitters, and the CW 936 transceiver was modified and fitted to transmit interrupted continuous waves for use in intrafleet communications as a replacement of motor buzzer sets.

1924

The Commander in Chief's report of communications during the winter exercises pointed out that,

although some improvement had been made in transmitters, unsatisfactory receiving equipment and lack of duplexing made Fleet radio communications entirely unsatisfactory. (19 F

A special board, appointed to investigate the deficiencies of radio communication within the Battle Fleet, reported that these were the result of a communication plan which was too complicated for the inadequate equipment and poorly trained personnel.

The Bureau of Engineering formulated a plan for the modernization and standardization of radio installations in capital ships. In accordance with the previous agreement to vacate the 500-1500 kcs. band, except on a noninterference basis, it envisioned the use of the 1500-4000 kcs. band for intrafleet communications.

The Commander in Chief, U.S. Fleet, commenting upon the Bureau of Engineering's modernization plan, stated that he could not concur in vacating the 500-1500 kcs. band until he could be assured that the 1500-4000 kcs. band would be satisfactory and that funds would be available to provide equipment utilizing that band. He further stated that, in his opinion, the number of commercial broadcast stations would be greatly reduced in the near future and that this would decrease the interferences in the broadcast band. (27 Mar.)

First transatlantic transmission of radio photo made by the Radio Corp. of America. (6 June)

Congress appropriated $1½ million for the modernization of naval communications.

Capt. Ridley McLean, USN, became Director of Naval Communications. (July)

Mr. M. P. Hanson, Naval Research Laboratory, designed the first high-frequency receiver, the Model RG, suitable for naval usage. The high-frequency transmitter built by the Laboratory the previous year and the RG receiver were used by the U.S.S. *Shenandoah* on her first round trip transcontinental flight. Almost continuous communications were maintained between the airship and the Laboratory during the flight.

The first sustained pilotless controlled flight of a plane was made using the Mirick remote radio control system and the Norden automatic pilot. The duration of this flight was 40 minutes, during which time it was put into the air, controlled through many maneuvers, and landed by a radio control station on the ground. (Prior to this both English and French personnel had managed to get a plane airborne and controlled for a few minutes.)

The Third National Radio Conference was convened in Washington, D.C. (6 Oct.)

The dirigible, U.S.S. *Los Angeles*, was delivered from Germany under its own power. It was equipped with German transmitters and receivers.

The Naval Research Laboratory in conjunction with amateurs, notably J. L. Reinartz and M. J. Lee, conducted studies of skip distances which resulted in the modification of existing wave propagation theories by Drs. A. H. Taylor and E. O. Hulbert of the Laboratory.

The Naval Research Laboratory reported that it was feasible to control a plane by radio beyond visual range. (22 Nov.)

Mr. L. A. Gebhard assisted by Messrs. Matthew Schenk and Edwin White, all of the Naval Research Laboratory, designed and constructed the first crystal-controlled high-frequency transmitter. They had the consultant services of Dr. Karl Van Dyke and Mr. Walter G. Cady, the country's two foremost authorities on quartz crystals.

1925

The Naval Research Laboratory completed the development of pulse radio transmitting equipment. This was done under the direction of Mr. L. A. Gebhard.

Congress extended the authority of naval radio stations to handle commercial and press traffic, on a noncompetitive basis, until 30 June 1927.

The greater portion of the $2½ million appropriated for the modernization of naval radio equipment during fiscal year 1925 lapsed because of lack of availability of equipment, lack of coordination between the Bureau of Engineering and the Bureau of Construction and Repair, the inability of the Bureau of Engineering and the Commander in Chief, U.S. Fleet, to agree upon a plan, and the lack of interest of most of the officers in the fleet.

U.S. Navy experimented in the use of high frequencies for communications on the U.S. Fleet cruise to Australia. The flagship, the U.S.S. *Seattle*, was able to maintain daily communications with the Navy Department, through the Naval Research Laboratory, during the major part of this cruise. Lt. Frederick Schnell, USNR and traffic manager of the American Radio Relay League, was called to active duty to conduct these tests in the U.S.S. *Seattle*. (June-Aug.)

The Naval Research Laboratory in cooperation with the Carnegie Institution confirmed the Kennelly-Heaviside Theory. The pulse transmitter developed by the Laboratory was utilized for this purpose.

Twenty-eight test flights of the Mirick remote radio control system and the Norden automatic pilot installed in a Vought plane were conducted between 19 June and this date. None were completely successful. (14 Sept.)

Following successful experiments utilizing high frequencies for long-distance communications, the Commander in Chief, U.S. Fleet, recommended the modification of the fleet frequency plan to utilize these frequencies. He further recommended that ship-shore circuits not use frequencies above 9000 kc. (Sept.)

A successful remote control flight was made using the Mirick remote radio control system and the Norden automatic pilot installed in a Vought plane. A safety pilot was in the plane. (28 Oct.)

An unsuccessful attempt was made to fly a Vought plane by remote radio control. Following this failure interest waned in the project and it remained almost dormant until 1936.

Lt. T. A. M. Craven, USN, assisted by officers of the Naval Communications Division developed a U.S. Navy radio frequency plan which utilized frequencies up to 20 mc. and used the broadcast band only on a noninterference basis.

1926

The Interdepartmental Radio Advisory Committee approved a U.S. Naval Communications Frequency Plan which utilized frequencies from 15 kc. to 19 mc. (25 Feb.)

S. C. Hooper became Head of the Radio Division of the Bureau of Engineering for the third time.

The Chief of the Bureau of Engineering released information concerning a revised radio modernization plan. (8 Mar.)

The Attorney General of the United States was forced, by court decision, to issue the edict that the Secretary of Commerce did not have the power to withhold radio transmitting licenses from reputable citizens. (16 Apr.)

The Radio Corp. of America established point-to-point radio facsimile service between New York and London and transmitted first commercial picture across the Atlantic. (1 May)

The performance of the Naval Research Laboratory XA high-frequency radio transmitter proved most satisfactory. (20 July)

Radio receivers powered by 110-volt alternating current were introduced for home use.

The Radio Division of Naval Research Laboratory was directed to cease operation and manufacture of radio equipment and to expend all its efforts on research and development. (27 Oct.)

The Radio Corp. of America, the General Electric Co., and the Westinghouse Electric & Manufacturing Co. were requested to cooperate with the Naval Research Laboratory in research,

development and design of new naval radio equipments. These companies took the position that such cooperation would endanger their own developments. (11 Nov.)

An 80-kw. vacuum tube transmitter was installed at the Naval Radio Station, San Diego (Chollas Heights), Calif.

Lt. Comdr. (later Rear Adm.) Richard Evelyn Byrd, USN (retired) flew over the North Pole. His aircraft was fitted with a high-frequency transmitter.

1927

Mr. P. T. Farnsworth filed a patent application covering an electronic television system. (7 Jan.)

The Radio Act of 1927 was enacted by Congress. This gave the Secretary of the Navy authority, under certain stipulations, to utilize all naval radio stations for the transmission and reception of commercial messages. Additionally, it authorized him to prescribe and collect reasonable tariffs for the handling of such messages.

President Coolidge approved the Radio Act of 1927, which established the Federal Radio Commission for a period of 1 year and vested in it the authority to license and control commercial and private radio transmitting stations. (23 Feb.)

The Federal Radio Commission was appointed. Rear Adm. W. H. G. Bullard, USN (retired), was the first chairman of the commission. (2 Mar.)

The Chief of Naval Operations approved a change in the modernization plan which eliminated installation of high-frequency radio equipments in numerous minor vessels. (31 Mar.)

The Bell Telephone Laboratories demonstrated landline television between Washington and New York and radio television between Whippany, N.J., and New York. (7 Apr.)

The Bell Telephone Laboratories demonstrated television, both image and sound, by means of a single radio transmitter using the same frequency band. (16 Apr.)

The Federal Radio Commission ordered 129 transmitting stations, which had been operating on unassigned frequencies, to return to those previously assigned them by the Department of Commerce.

Capt. T. T. Craven, USN, became Director of Naval Communications. (June)

The Commander in Chief, U.S. Fleet, requested more modern receivers powered by alternating current. (July)

The Fourth International Radio Conference was opened in Washington with a welcoming address by President Coolidge. Secretary of Commerce Hoover was the presiding officer of the conference. Capt. T. T. Craven, USN, was one of the U.S. delegates. Among other things, it established a permanent International Consulting Committee on Radio Communications to provide opinions and advice on technical questions of radio communications. (4 Oct.)

The first experimental sets of underwater supersonic echo ranging devices were installed in several naval vessels.

The Submarine Signal Co. began producing the Fathometer. This quickly became a standard installation for U.S. naval vessels.

1928

Congress reluctantly extended the authority of the Federal Radio Commission another year.

The National Broadcasting Co. received its first television station construction permit. (4 Apr.)

Rapid progress had been made in the modernization of fleet and shore radio equipment. (July)

Hooper became Director of Naval Communications and was relieved as Head of the Radio Division

by E. C. Raquet. (July)

The reception of transmissions during the entire cross-country flight of an airplane was achieved by the Naval Research Laboratory.

The U.S. Government commenced installations of radio ranges as aircraft aids to navigation.

The U.S. Supreme Court reversed rulings of lower courts and awarded priority of invention of the "feedback" circuit to De Forest. (29 Oct.)

Dr. V. K. Zworykin of the Radio Corp. of America was granted U.S. Patent 1,691,324. This related principally to color television.

Commander (later Rear Adm.) Richard Evelyn Byrd, USN, (retired), headed an aerial exploration over the South Pole. The Naval Communication Service assisted him in this endeavor. One of the most notable accomplishments of the expedition was the transmission of more than 300,000 groups of press messages to the New York Times.

1929

The Convention and Regulations adopted by the Fourth International Radio Conference became effective. This included an allocation of frequency bands by usages based upon a plan adopted earlier by the U.S. Navy. (1 Jan.)

The Radio Corp. of America acquired control of the Victor Talking Machine Co.

Application for a patent on the Espenschied-Affel coaxial transmission cable was made. (23 May)

The Chief of Naval Operations approved a change to the 1926 radio modernization plan designed to meet the growing radio communications requirements of the fleet. (1 June)

The Naval Research Laboratory produced the JK electronic listening device which replaced the acoustic devices fitted in submarines.

The Naval Communication Service established area communication officers in the Atlantic, Pacific and Asiatic zones.

The Naval Communication Service conducted experiments to adapt the teletypewriter to radio.

Dr. A. W. Hull of the General Electric Co. announced the development of the screen-grid electronic tube.

Congress again extended the time limit and authority of the Federal Radio Commission.

Dr. V. K. Zworykin of the Radio Corp. of America demonstrated the kinescope (cathode ray television picture tube). (18 Nov.)

Rear Adm. R. E. Byrd, USN, (retired), flight over the South Pole was announced by radio from Little America, Antarctica.

1930

The London Naval Conference convened. (21 Jan.) The Bell Telephone Laboratories demonstrated two-way landline television between stations 2 miles apart. (9 Apr.)

The "Annual Report of the Commander in Chief, U.S. Fleet," acknowledge the great improvement made in naval communications but continued to stress the need for more modern receivers. (1 July)

The Naval Research Laboratory designed and developed an RAC low-frequency barrage receiver for use at shore radio stations.

The Radio Corp. of America-Victor was awarded contract for design, development and manufacture of models RAA and RAB radio receivers.

Models TAU, TAZ, TBA, TBB, and TBC transmitters were purchased.

The JK listening device was modified by the addition of a small transmitter which produced "pings" which were utilized for underwater communications.

The Director, Naval Research Laboratory, submitted a detailed report on "Radio-Echo Signals from Moving Objects" to the Chief of the Bureau of Engineering. (5 Nov.)

The Bureau of Engineering directed the Naval Research Laboratory to investigate the use of radio to detect the presence of enemy vessels and aircraft.

Comdr. S. A. Monahan, USN, became Head of the Radio Division, Bureau of Engineering. (Dec.)

Direct commercial radio communications finally established between the United States and China.

Mr. P. T. Farnsworth advised the Federal Radio Commission that he had succeeded in narrowing the band required for television to 6000 kc.

1931

The Naval Research Laboratory developed the QB echo ranging sonar. This was fitted in newly constructed submarines in addition to the JK apparatus. This transducer utilized newly developed Rochelle salt crystals instead of quartz.

Models RAA and RAW superheterodyne, alternating current receivers installed afloat.

The U.S. Navy possessed the most modern and the most efficient radio system of any Navy.

Radio Section, Design Branch, Material Division, Bureau of Aeronautics, was established. (Aug.)

Mr. L. A. Hyland of the Naval Research Laboratory discovered that the echos of radio waves revealed the presence and location of aircraft in flight. (Sept.)

1932

Radio Section, Design Branch, Material Division, Bureau of Aeronautics, was retitled the Radio and Electrical Section. (Apr.)

The first of several high-powered vacuum tube transmitters was delivered the U.S. Navy and installed in the Naval Radio Station, Cavite, P.I.

A complete radio detection system for the air surveillance of an area about 30 miles in diameter was devised and enough components were installed to prove its capabilities. It was not satisfactory for shipboard usage and the Secretary of the Navy suggested it might meet the requirements of the Army.

The Fifth International Radio Conference convened in Madrid, Spain. The convention adopted by this conference was concerned with modifying the Washington Convention by providing additional channels for aviation communications and the further assignments of specific high-frequency long-distance communications channels.

1933

The Chief of Naval Operations was requested to provide forces afloat with high-speed, radio-control-led aerial targets. (22 Apr.)

The Director, Naval Research Laboratory advised the Bureau of Ordnance of the possibilities of controlling gunfire by microwave radio. (15 Sept.)

Comdr. W. J. Ruble, USN, became Head of the Radio Division, Bureau of Engineering. (Oct.)

The Washington Navy Yard had produced 20 sets of QB sonar. This was not sufficient and the Submarine Signal Co. was awarded a contract to provide 30 additional sets.

The Naval Research Laboratory in collaboration with the Goodrich Tire and Rubber Co. developed a spherical cover for the QB transducer which permitted submarines to make speeds up to 10 knots before water noises became excessive.

1934

Dr. V. K. Zworykin proposed the Navy develop an unmanned aerial torpedo. Naval officials concluded that it was unsuited as a naval weapon because of its weight, complexity and lack of penetration.

The Naval Research Laboratory designed, developed and constructed the world's first radar equipment.

Dr. R. M. Page was placed in charge of a special section of the Naval Research Laboratory to push radar and other high-frequency radio projects.

Dr. R. M. Page and his assistants at the Naval Research Laboratory designed and constructed their first radar equipment. During tests in December it proved unsatisfactory.

Mr. Leo Young suggested that pulse radio transmission might make it possible to colocate a radar transmitter and receiver. (Mar.)

The Communications Act of 1934 was signed by President Roosevelt. This established the Federal Communications Commission as the successor to the Federal Radio Commission. (9 June)

The Naval Research Laboratory developed a sonar transducer which utilized magnetostriction tubes instead of salt crystals. The Submarine Signal Co. began production of these at an annual rate of approximately 14. This company also adopted this transducer for use in the Fathometer.

Mr. W. F. Curtis of the Naval Research Laboratory experimented with magnetrons at about 750 mc.

Eitel-McCullough, Inc., developed a triode of greater efficiency. It was designated the 100 TH.

The U.S. Supreme Court upheld De Forest as the inventor of the "feedback" circuit. (9 Oct.)

Joint agreement between the Chiefs, Bureau of Engineering and Bureau of Aeronautics, provided that the latter would initiate all procurement requests for aircraft radio equipment and that the former would issue the requisitions and select the contractors subject to the latter's approval. (22 Oct.)

1935

The Naval Research Laboratory in collaboration with the Wood's Hole Oceanographic Institute instituted a study of oceanography and underwater sounds to determine the cause of the vagaries being encountered in the use of sonar.

The Radio Corp. announced that it would allocate $1 million for field television tests. (7 May)

Rear Adm. C. E. Courtney, USN, became Director of Naval Communications. (July)

Personnel of the Naval Research Laboratory under the direction of Dr. R. M. Page completed the design of the pulse radar transmitter circuit.

Mr. E. H. Armstrong demonstrated a frequency modulation system using a 2.5 meter wave. (6 Nov.)

1936

The Bell Telephone Laboratories developed coaxial transmission lines and waveguides.

The Chief of Naval Operations addressed a letter to the Bureaus of Ordnance, Aeronautics, and Engineering calling their attention to the urgent need of radio-controlled aerial targets. (23 Mar.)

The use of hollow tubing as a "waveguide" for the transmission of ultra-high-frequency radio waves

was reported by Bell Laboratories and the Massachusetts Institute of Technology. (30 Apr.)

The Chief of Naval Operations directed the Bureaus of Aeronautics and Engineering to proceed with the development of four radio-controlled aircraft. (1 May)

Tests of the Naval Research Laboratory designed and constructed pulse radar equipment were successful. This used separate transmitting and receiving antennaes. Mr. Leo Young of the Laboratory suggested the means of utilizing the same antenna for both purposes.

The Radio Corp. of America began tests to demonstrate the value of television in aerial reconnaissance.

The Bell System provided the first coaxial cable for television use between the studio and transmitter of the National Broadcasting Co. in New York. (10 June)

The Navy's pulse radar system was demonstrated to high Government officials. (10 June)

The Radio Corp. of America demonstrated ultra-short-wave radio facsimile between New York and Philadelphia using two automatic relay stations between the terminals. (10 June)

The Radio Corp. of America demonstrated the operation of a complete two-way radio relay system, using frequencies above 30 mc. between New York and Philadelphia. (11 June)

The Chief of the Bureau of Engineering directed that the Navy's radar project be given the highest possible priority. (12 June)

The duplexer, permitting use of a single radar antenna, designed and developed by the Naval Research Laboratory, was completed.

The Naval Research Laboratory commenced design and development of two sets of radar equipment for shipboard installation. One was a 200 mc. pulse type, the other a 1,200 mc. phase shift type, modulated at 30 kc.

The Bureau of Aeronautics established a radiocontrolled aircraft project under the direction of Lt. Comdr. D. S. Fahrney, USN. (20 July)

Personnel of the Naval Research Laboratory used the magnetron to produce oscillations at 3,000 mc. but did not achieve reliability.

The Fleet Sonar School was established at San Diego, Calif. to train sonar operators in its use and in the science of oceanography.

The American Telephone & Telegraph Co. coaxial cable between Philadelphia and New York was placed under test. (1 Dec.)

The Secretary of the Navy approved a joint agreement between the Chiefs of the Bureaus of Engineering and Aeronautics wherein the former was made responsible for research, design, development, and procurement of aircraft radio equipment subject to the approval of the latter. The Bureau of Aeronautics was to define policies subject to the approval of the Chief of Naval Operations and was to provide specific items which it desired research and development pushed. Direct charges of these programs were to be financed by the Bureau of Aeronautics. (31 Dec.)

1937

The Naval Research Laboratory made complete disclosure of its radar development to the Army Signal Corps Laboratory. (18 Jan.)

The Philco Radio & Television Corp. demonstrated television of 44 lines in a 3-mile test in Philadelphia. (11 Feb.)

Personnel of the Naval Research Laboratory completed the development and satisfactorily operated the control system of a drone at a distance of 25 miles. The design and development of the control equipment was carried out under the direction of Mr. Matthew Schrenk. (17 Feb.)

A board of officers convened to examine a proposal of Dr. V. K. Zworykin to develop guided missiles

reported unfavorably on the project. (27 Feb.)

A Navy drone, with safety pilot, was controlled in flight by radio. (29 Mar.)

The Assistant Secretary of the Navy and the Chief of Naval Operations witnessed a demonstration of Navy developed radar equipment.

Two radar sets were installed in the U.S.S. *Leary* for testing. The pulse-type equipment located planes at ranges of 18 miles.

Mr. V. K. Zworykin of the Radio Corp. of America demonstrated an electron projection "gun" which projected television pictures on an 8-inch by 10-inch screen. (12 May)

Capt. Leigh Noyes, USN, became Director of Naval Communications.

Complete disclosure of all technical details of radar were made by the Naval Research Laboratory to Bell Telephone Laboratory engineers and Western Electric Co. officials. The latter made a proposal to develop a 700-mc. equipment. (13 July)

Mr. T. A. M. Craven appointed a member of the Federal Communications Commission. (17 July)

The Army Signal Corps demonstrated a pulse-type radar based upon development work accomplished after they were provided information by the Naval Research Laboratory. (30 July)

The Federal Communications Commission authorized tests of radio facsimile on regular broadcast channels during early morning hours.

The Federal Communications Commission opened the spectrum to 30 mc. for various non-Government services and experimenters. (15 Oct.)

The Chief of the Bureau of Aeronautics directed an investigation be made concerning the use of radio control for flight-testing new aircraft.

A pilotless Navy drone was taken off the ground by a ground radio control station, maneuvered in the air by an airborne control station, and then landed by the ground control station. It was a hard landing which carried away a part of the landing gear. (15 Nov.)

A pilotless drone was put in the air, maneuvered, and landed without accident. (25 Dec.)

A conference of North American countries was held at Ottawa to ease the broadcast interferences between nations.

A conference of Western Hemisphere countries was convened in Lima, Peru, to discuss aeronautical radio problems.

A conference of Western Hemisphere countries convened in Havana, Cuba, to consider Western Hemisphere positions at the Sixth International Radio Conference.

1938

Two pulse radars, one directed ahead and the other down, were installed in a plane by RCA engineers as a safety-in-flight system.

The Federal Communications Commission allocated a band of 25 ultrahigh frequencies for noncommercial educational broadcasts. (27 Jan.)

The Sixth International Radio Conference convened in Cairo, Egypt. Capt. S. C. Hooper, USN, was one of the four U.S. delegates. As in the Madrid Conference, this one was primarily concerned with providing increased radio facilities for aviators, plus the allocation of the uses of the newly developed portion of the radio spectrum between 30 and 300 mc. (1 Feb.)

The Naval Research Laboratory was directed to complete a 200-mc. radar for shipboard installation and test prior to end of year. This was given the designation XAF. (24 Feb.)

The basic principles of radar were divulged to engineers of the Radio Corp. of America and that firm was given a contract to develop an experimental radar in the 400-mc. band. This equipment was for shipboard installation and test and was required to be ready for installation and test prior to the end of

the year. This set was designated CXZ.

Lt. Comdr. J. H. Dow, USN, became Head of the Radio Division, Bureau of Engineering.

A 200-mc. radar equipment, utilizing a "multiple-tube ring-mounted transmitter oscillator" suggested by Dr. R. M. Page of the Naval Research Laboratory, was completed. It was successful in detecting aircraft for distances up to 48 miles.

The first operational radar installation on a U.S. Navy vessel was fitted in the U.S.S. *New York.*

Extensive training exercises were established for Naval Communications Reserve personnel. Over 2,700 private and Government stations were involved in these exercises.

A drone was first used by the Navy as an aerial target for the U.S.S. *Ranger.* Her antiaircraft batteries failed to make a hit on either of two runs.

A drone was used to simulate a dive-bombing attack on the U.S.S. *Utah.* It was brought down by a hit by the second salvo. (14 Sept.)

The Bell Telephone Laboratories demonstrated a radar altimeter. (10 Oct.)

1939

Mr. E. H. Armstrong demonstrated the use of frequency-modulated transmissions on 7.5 meters with a 40-kw. transmitter. (17 Jan.)

Tests of XAF and CXZ radar sets completed in the fleet. The XAF was considered very satisfactory but the CXZ proved of little value because of its hurried design and construction. (24 Mar.)

The Bell Telephone Laboratories designed, constructed and tested a 500-mc. radar. It was satisfactory for some applications but not for the control of gunfire.

Contracts were awarded the Submarine Signal Co. and the Radio Corp. of America for sonar equipments to equip all U.S. destroyers.

The radio equipment of the Navy, installed in the late 1920's and early 1930's was rapidly becoming obsolescent.

The Naval Radio Station, Cheltenham, Md., was commissioned as the radio-receiving center for the Navy Department and Potomac and Severn River naval activities.

The National Broadcasting Co. applied for a license for a frequency-modulated transmitting station. (13 July)

England and France declared war on Germany. The Navy awarded first contracts for commercially manufactured radar equipments.

Tests with television equipment in aircraft were commenced by the Naval Aircraft Factory.

Contract awarded the Radio Corp. of America for the construction of six "Chinese copies" of the XAF radar equipment.

Rear Adm. Richard Evelyn Byrd, USN, (retired), led a second Antarctic exploration expedition. He was provided Navy communications personnel and equipment.

Personnel of the Naval Research Laboratory designed and developed a radio altimeter using a 500-mc. transmitter. It was placed under commercial production.

Dr. R. M. Page in a report to the Director, Naval Research Laboratory, stressed the need of a new tube to permit utilization of higher frequencies for radar in order to reduce antenna size and weight.

During this year the Navy expended $1,500,000 for the purchase and maintenance of electronic equipments.

In the Navy there were approximately 122,000 personnel. Of this number, about 1,500 officers and 10,500 men were engaged in communications.

1940

There were 743 licensed radio stations broadcasting to 45,300,000 receivers. Nine experimental frequency-modulated stations were licensed at this time. (1 Jan.)

Radio Corp. of America engineers designed a compact transmitter and camera to provide airborne television.

A Naval Research Laboratory report reiterated the requirement for developing a new tube in order utilize higher frequencies in radar equipments and stated the importance of integrating identification and recognition systems with radar. It also emphasized the necessity of applying radar to fire control and the development of repeater units and the plan position indicator. (26 Feb.)

The Federal Communications Commission approved limited commercial television operations effective September 1940.

The Chief of the Bureau of Aeronautics directed that a radio-controlled plane be fitted to fly at a set altitude, just clear of the water to determine the practicability of the use of radio-controlled torpedoes. The tests indicated that it could be flown into a target consistently by a control operator flying 1½ miles astern of it.

A decision of the Supreme Court made it possible for the Federal Communications Commission to license new broadcast stations without regard to possible economic injury to existent stations.

The Western Electric Co. was awarded a developmental contract for one fire-control radar, designated CXAS.

President Roosevelt directed that every effort be exerted to prevent a monopoly of television.

The Naval Research Laboratory requested that funds for radar research for fiscal year 1941 be more than doubled.

The Radio Corp delivered six radar equipments, designated CXAM, to the Navy.

The Federal Communications Commission unanimously rescinded its 28 February order that limited commercial television operations would begin on 1 September 1940.

The Chief of Naval Operations directed immediate expedition of radar research. (1 June)

Public Law 671 was enacted. This eliminated archaic methods of material procurement. Italy entered the war as an Axis partner.

France capitulated to Germany. (17 June)

The National Defense Research Committee was established. (27 June)

The Bureau of Engineering and the Bureau of Construction and Repair were consolidated into a single Bureau of Ships. Concurrent with a departmental reorganization, the Radio and Sound Division became the Radio and Sound Branch, Design Division, Bureau of Ships. (1 July)

Comdr. A. J. Spriggs, USN, became Head of the Radio and Sound Branch, Bureau of Ships.

The Federal Communications Commission announced that it had authorized 22 experimental frequency-modulated transmitter stations.

A Microwave Research Committee was established under the National Defense Research Committee.

The Navy negotiated a contract with the Radio Corp. of America for 14 CXAM-1 radar equipments.

The Chief of the Bureau of Ships stated that the Navy would require $10 million for radar, research, development and procurement in 1941 and twice that amount in 1942.

The Western Electric Co. was awarded a contract for surface fire-control radar equipment operating at 500 mc. (25 July)

The Bureau of Ordnance made an informal request to the National Defense Research Committee for the development of a proximity fuze. (12 Aug.)

The National Defense Research Committee established a section under Dr. M. A. Tuve to conduct research looking to the development of a proximity fuze. (17 Aug.)

Commercially constructed radar equipments were installed in some Navy vessels.

The British Technical Mission arrived in Washington for the purpose of exchanging research information with the National Defense Research Committee.

The U.S. Government was advised of the British improvement to the magnetron which made it capable of supplying oscillator power in the microwave band.

The Defense Communications Board was created to plan for the use of communications in the National defense. Its original members were James L. Fly of the Federal Communications Commission; Rear Adm. Lee Noyes, USN; Maj. Gen. J. O. Mangborne, USA; H. E. Gaston, Treasury Department; and Breckinridge Long, State Department.

The first multicavity resonator magnetron constructed in this country was completed at the Bell Telephone Laboratories. (10 Oct.)

The British Technical Mission suggested that the United States undertake the development of a microwave aircraft interception system and a microwave antiaircraft fire control system.

Upon resumption of military scientific exchange with England, it was discovered that underwater sound developments in the two countries had been almost parallel. England had continued the use of quartz-steel transducers in their Asdic but had developed a streamlined dome which further reduced water noises. The Asdic was capable of permanent recording ranges. The United States adopted both of these improvements.

The Chief of the Bureau of Aeronautics advised the Chief of Naval Operations that a number of projects were under examination, some of which would lead to the development of a guided missile.

The Federal Communications Commission issued the first construction permits for frequency-modulated broadcast stations. (31 Oct.)

The Radiation Laboratory, under the administration of the Massachusetts Institute of Technology, was established by the Microwave Committee and commenced operations.

Mr. Alfred L. Loomis made the initial suggestion for an electronic air navigation system which was later developed into Loran (long range navigation system) by the Radiation Laboratory of the Massachusetts Institute of Technology.

The use of the term "radar" was directed by the Chief of Naval Operations in nonclassified reference to "radio detection and ranging." (18 Nov.)

The Western Electric Co. was awarded a contract for 10 CXAS-1 (later designated FA) fire-control radars. (2 Dec.)

The Navy purchased a quantity of British 175-mc. airborne search radars. These were modified by the addition of a duplexing system and the elimination of one antenna.

The Naval Research Laboratory designed and developed the XAR 200-mc. search radar. Contracts were awarded the General Electric Co. and the Radio Corp. of America for engineering and producing equipments based upon the Laboratory models. These were designated the SC and SA, respectively.

The Naval Research Laboratory designed and developed an aircraft warning radar for submarines using the 114-mc. band. It was engineered and first produced by the Radio Corp. of America and was designated SD.

1941

There were 802 licensed radio broadcast stations transmitting to over 51 million receivers. (1 Jan.)

The Naval Research Laboratory commenced conversion of the radio pulse altimeter to an airborne search radar.

A 10,000-mc. multicavity resonator magnetron was completed and tested by the Bell Telephone Laboratories. It did not produce satisfactory peak-pulse power. (18 Jan.)

The Radio Corp. of America completed the development of a radar altimeter which gave excellent

low-altitude performance. (27 Jan.)

U.S. Navy directed concentration on the development of an electronic proximity fuze.

A 700-mc. multicavity resonator magnetron was completed and tested at the Bell Telephone Laboratories. (14 Feb.)

Tests of Radio Corp. of America television equipment provided usable picture informations from a plane in flight to a ground receiver station up to a distance of 30 miles. (17 Feb.)

Dr. R. M. Page of the Naval Research Laboratory designed and developed the plan position indicator.

In consonance with the agreement reached at the Regional Radio Conference at Havana, Cuba, the frequency assignments of 777 United States broadcasting stations were reallocated.

The National Defense Research Council established a division under Dr. J. F. Tate to conduct research in underwater sound and oceanography. Numerous contracts were awarded scientific groups and universities to assist in this program.

The Chief of the Bureau of Ordnance suggested that all-out efforts should be made to develop the guided missile. (15 Apr.)

The Chief of the Bureau of Aeronautics advised that progress in the guided missile program was satisfactory and that radar was being developed as a guidance system. (18 Apr.)

Lt. Comdr. G. G. B. Hall, USN, became Head of the Radio and Electrical Section, Design Branch, Material Division, Bureau of Aeronautics. (24 Apr.)

The Aircraft Radio Maintenance Section, Maintenance Division, Bureau of Aeronautics, was established. (1 May)

An improved 700-mc. multicavity resonator magnetron was completed, tested at the Bell Telephone Laboratories, and placed under production by the Western Electric Co.

A "breadboard" model of the (SG) microwave surface-search radar, equipped with the Naval Research Laboratory plan position indicator, was tested on the U.S.S. *Semmes*. It produced excellent results.

Tests of airborne television equipment provided pictures of sufficient quality on the receiver in another plane to permit the pilot of the latter to direct the pilot of the former to pass directly over a preselected target.

The Radio Corp. of America developed a small television system which weighed only 70 pounds and proved successful in providing telemetering information.

The SG microwave surface-search radar was placed under production contract.

A "breadboard" model of the FC surface fire-control radar was completed and tested. Its performance was far superior to the model FA and it was placed under limited production.

An improved 10,000-mc. multicavity resonator magnetron was completed and tested by the Bell Telephone Laboratories. Plans were made to place this under contract but the strapped magnetron was developed prior to production. (11 June)

The Bureau of Aeronautics abandoned its previous policy of installing electronic equipment in planes and established the policy of having aircraft contractors install nonclassified equipments.

Commercial operation of television began in the United States with 21 licensed transmitting stations.

The Naval Research Laboratory commenced the development of a drone radar and radar repeatback system. The National Defense Research Council commenced the development of a drone 3-cm. radar recognition system. (1 Aug)

Forty-seven of fifty simulated torpedo attacks with the guided missile carried out during the month were successful.

The first model FD aerial radar fire-control system was completed and tested satisfactorily. It was later installed in the U.S.S. *Roe*. (28 Aug.)

The Bell Telephone Laboratories developed "lobing."

Numerous commercial companies participated in research and development of the proximity fuze.

The Naval Research Laboratory provided the Westinghouse Electric & Manufacturing Co. and the

Radio Corp. of America information on which to construct preproduction models of the airborne search radar conversion from the radio pulse altimeter. It was designated ASB.

British scientists at Birmingham University developed the strapped magnetron. The Bell Telephone Laboratories produced a similar one within a week after receiving information concerning this tube.

Destroyers, totalling 170, were the only United States naval vessels equipped with sonar.

Delivery of production models of the FD radar commenced.

Japan attacked Pearl Harbor, Hawaii, at 1300 e.s.t. (7 Dec.)

All United States amateur radio stations closed by order of the Federal Communications Commission.

The U.S. Government declared war on Japan, Germany and Italy.

Comdr. J. B. Dow, USN, became the Head of the Radio and Sound Branch, Design Division, Bureau of Ships.

The Navy established its first landline teletypewriter system linking naval activities at Washington, Norfolk, Philadelphia, New York, New London, Boston, and Portsmouth, N.H.

President Roosevelt established a Director of Censorship for radio and press. The U.S. Weather Bureau placed a ban on all weather broadcasts.

President Roosevelt granted the military departments authority to negotiate contracts. (27 Dec.)

Mr. Loren F. Jones completed the development of *teleran* (television radar air navigation system).

1942

By the beginning of this year an airborne microwave radar set (ASV) for the detection of surface vessels had been developed and placed under production.

The Office of Procurement and Material was established within the Navy Department. This office was authorized to act for the War Production Board.

Material procurement was handicapped by lack of allowances, archaic methods of procurement, lack of price experience, and insufficient production capabilities.

The Production Division, Bureau of Aeronautics, took over the responsibility for financing and procuring aircraft radio equipments.

Quantity production of good, high-power 3,000 and 10,00-mc. strapped magnetrons was commenced by the Western Electric and other manufacturing companies.

Office of Facts and Figures (Office of War Information) designated as clearinghouse for U.S. Government radio broadcasts. (16 Jan.)

Trials of the proximity fuze proved successful.

War Production Board, advised the electronic industry that it must be converted totally to war production within 4 months. (13 Feb.)

A thorough study of the physical and electrical characteristics of each ship type was commenced.

The responsibility for research and development of the proximity fuze was transferred to the Director of the Office of Scientific Research and Development and was placed under the administration of Johns Hopkins University's Applied Physics Laboratory.

War Production Board ordered radio manufacturers to discontinue making radios and phonographs for civilian use by 23 April. (7 Mar.)

The Chief of Naval Operations directed tests be conducted to determine the necessary characteristics for assault drones and their control planes and the tactical employment of assault drones.

The Bureau of Aeronautics was directed to procure 200 expendable assault drones. (23 Mar.)

Further tests of the proximity fuze indicated that the design was satisfactory.

War Production Board ordered electronic tube manufacturers to discontinue the production of 349

types of tubes by April to save critical materials and manpower. (17 Apr.)

The Naval Electronics Laboratory was established at San Diego, Calif.

Delivery of airborne search radars (ASB) was commenced.

An electronics procurement section was established in the Radio Branch, Design Division, Bureau of Ships. All procurements were thereafter made by that section.

The Naval Aircraft Factory was directed to make a study of controlling assault drones from surface vessels and submarines by means of radio and 3- or 10-cm. radar.

The Vice Chief of Naval Operations established Project Option, appointed Capt. Oscar Smith, USN, as his direct representative for this assault drone program, and directed that the number of drones to be procured be increased from 200 to 1,000.

The Chief of the Bureau of Aeronautics requested that Project Option be cut by 50 per cent because of the enormous effect the original plan had upon training and upon the overloaded aircraft industry. (29 June)

All domestic radiotelegraph operations were discontinued by U.S. Government order.

The Army-Navy Communications Production Expediting Agency was established.

A Progress Section, Production and Procurement Branch, Bureau of Ships, was established to bolster the Navy's electronic production program.

The Seventh International Radio Conference which had been scheduled to be held in Rome was not convened at that time. It was finally held at Atlantic City, N.J., following the termination of hostilities.

The Chief of Naval Operations approved cutting back Project Option by 50 percent. (12 Aug.)

The U.S.S. *Cleveland*, testing the proximity fuze under simulated battle conditions, destroyed all the three provided drones with four proximity bursts. (12 Aug.)

The Radio Corp. of America developed a radar "sniffer" for aircraft or drone which could detect a target ahead and cause a torpedo to be launched or a bomb to be dropped at a preselected distance from the target. At the suggestion of Lt. M. B. Taylor, USN, right and left switching was added to make this device "target seeking."

Mass production of proximity fuzes commenced. Initial cost per fuze was $732. Procurement contracts were let in the amount of $60 million.

The "maintenance of true bearing" instrument, the "bearing deviation indicator" and the "reverberation gain control" instrument were developed to increase the efficiency of sonar equipments.

The first Loran System (long range navigation system) was placed in operation with four stations between the Chesapeake Capes and Nova Scotia.

The expanding scope of electronics necessitated the reestablishment of the Radio and Sound Division, Bureau of Ships.

The U.S. Government (Office of War Information) took over the operations of short-wave broadcasting stations. (1 Nov.)

The Army-Navy Communications Production Expediting Agency was reorganized and retitled the Army-Navy Electronics Production Agency (ANEPA).

The effectiveness of sonar was demonstrated when 1,065 assorted Allied vessels made passages from United States and United Kingdom ports to North Africa with the loss of only 23 ships despite a vigorous submarine offensive.

Electronics played an important part in the Allied invasion of North Africa.

Sonar production facilities of the Submarine Signal Co. and the Radio Corp. of America were greatly expanded. Additional companies established facilities and began producing sonar equipment. The Navy began fitting lightweight sonars in torpedo patrol boats, submarine chasers, motorboats and yachts. Bathythermographs were provided vessels for the purpose of locating thermoclines and increasing the efficiency of the use of sonar.

The Bureau of Ships abandoned a policy of earmarking electronics equipments for a particular activity

and established pools of electronics equipment at navy yards and overseas bases.

Twelve assault drones delivered and underwent Board of Inspection and Survey trials.

The Secretary of the Navy approved a clarification of the joint agreement between the Chiefs of the Bureaus of Engineering and Aeronautics which stated that the Bureau of Aeronautics controlled and prepared descriptive performance specifications of aircraft electronics equipments. (4 Dec.)

Comdr. Frank Akers, USN, became Head of the Radio and Electrical Section, Design Branch, Material Division, Bureau of Aeronautics.

The Secretary of the Navy directed the material bureaus to handle their own contracts for research, development and procurement of technical items under each Bureau's cognizance. Procurement of standard items of a nontechnical nature remained the responsibility of the Bureau of Supplies and Accounts. (13 Dec.)

1943

The U.S.S. *Helena* fired the first proximity fuzes used in combat. (5 Jan.)

It was recommended that the "airborne remote control bomb" (assault drone) be brought into early action by trained crews and in sufficient numbers to benefit from its surprise use. (8 Mar.)

The Chief of Naval Operations directed that plans and training for use of the assault drone proceed immediately and rapidly. On this date Project Option was increased to 3,000 drones with a delivery rate of 250 per month to be achieved by June 1944. (23 Mar.)

The Naval Aircraft Factory was directed to manufacture 100 plywood assault drones and to contract for another hundred to be delivered prior to November 1943. (30 Mar.)

The Radio Corp. of America completed development of the "supersniffer" which had all the capabilities of the "sniffer" and the added one of being able to search an arc ahead and lock upon a discovered target. The specifications for this device required a range of 2 miles.

At the request of the Chief of the Bureau of Aeronautics, Project Option was cut back to 2,000 assault drones. (12 Apr.)

The "Chain Broadcasting Regulations" issued by the Federal Communications Commission became effective following a Supreme Court decision upholding their validity.

Sonobuoys, which could be dropped from planes, and high-frequency direction finder stations were used to guide planes and hunter-killer groups to German submarine wolf packs.

The Radio and Electrical Branch, Engineering Division, Bureau of Aeronautics, was established.

Procurement contracts for proximity fuzes totalled $200 million.

The Commander in Chief, Pacific Fleet, recommended against the use of the assault drones in his theater of action. This was based upon the lack of available carriers, the low speed and poor maneuverability of the drones and because conventional weapons were winning the war in that area. (22 Sept.)

1944

Captain H. B. Temple, USN, became head of the guided missile program in the Office of Chief of Naval Operations. Following a study of the program, he recommended that it be cut back and changed to a "combat test" program. (15 Feb.)

The number of assault drones was reduced to a total of 388. No reduction was made in the procurement of electronic equipment since it was planned to use this in obsolete aircraft. (5 Mar.)

Germany began V-bomb attack on England.

The Army-Navy Electronics Production Agency (ANEPA) was disestablished despite Navy opposition. This left the Navy with inadequate field expediting services.

The Radio and Sound Division was reorganized and established as the Electronics Division, Bureau of Ships.

Bureau of Ships electronic procurement was transferred to a Contract Division. A Contract Planning Section was established in the Equipment Branch of the Electronics Division to provide technical assistance to the Contract Division.

Approved contractors began fitting newly constructed aircraft with complete electronics installations.

There were more than 22,000 officers and 225,000 enlisted personnel engaged in U.S. Naval Communications.

Radio photo (facsimile) equipments were installed at Naval Communications stations at Washington, San Francisco, Pearl Harbor, and Guam.

Successful tests of radioteletypewriter equipments were conducted on several fleet radio circuits.

Major fleet radio circuits were equipped with radioteletypewriter equipments.

The proximity fuze was instrumental in defeating the German *V-1* attacks on London and Antwerp.

A military armistice was signed between the Allies and Italy. (8 Sept.)

The Allies gained the initiative in the Battle of the Atlantic.

The German Navy developed and equipped their submarines with snorkels, remained submerged for long periods, ceased using high-frequency radio, and reduced the effectiveness of our antisubmarine measures.

Proximity fuzes were used against enemy infantry at the Battle of the Bulge and were instrumental in changing the tide of victory. Procurement contracts for the fuze amounted to $300 million for the year 1944.

The Bureau of Ordnance relieved the Office of Scientific Research Development of all responsibility for the proximity fuze program. The Applied Physics Laboratory continued to administer the program.

Allies maintained the initiative in the Battle of the Atlantic, sinking 88 submarines and about 100 midgets while losing only 56 ships.

1945

Nine hundred and forty-three broadcasting stations held licenses in the United States. Seven hundred and thirty of those stations were affiliated with broadcast networks. (1 Jan.)

Nine commercial television stations were in operation. 12 applications for operation of television stations were on file with the Federal Communications Commission.

T. A. M. Craven was succeeded by Charles R. Denny as a member of the Federal Communications Commission. (14 Mar.)

Germany unconditionally surrendered to the Allies. (7 May)

The Federal Communications Commission reported 46 commercial frequency-modulated stations were in regular operation and that they had 403 applications for new frequency-modulated stations on file. (30 May)

The Federal Communications Commission announced frequency allocations from 10 kc. to 30 mc. for nongovernmental services. These allocations included bands for frequency-modulated transmissions and for television. (27 June)

The world's first atomic bomb used in offensive operations was dropped on Hiroshima, Japan. (6 Aug.)

An atomic bomb was dropped on Nagasaki, Japan.

Japan accepted allied surrender terms. (14 Aug.)

The War Production Board removed the wartime controls on the manufacture of radio equipment for civilian usage. (20 Aug.)

The Federal Communications Commission lifted the wartime ban on one amateur radio band.

The Office of War Information was abolished by Executive order. (31 Aug.)

Between November 1942 and this date, contracts had been awarded for electronic equipment in the value of $4,009 million. During the same period, deliveries had been made in the amount of $2,538,000. (1 Sept.)

Formal singing of the surrender document on board the U.S.S. *Missouri* was transmitted from that ship to the naval radio station, Mare Island, Calif., by radio photo. (1 Sept.)

The Radio Technical Planning Board was organized to advise government, industry, and the public of the engineering considerations involved in the future utilization of electronics. (15 Sept.)

The War Production Board announced that $7,680 million was the approximate value of electronic equipment delivered for war purposes between July 1940 and July 1945. More than 550,000 workers in over 1,600 factories contributed to that effort. (5 Oct.)

The Federal Communications Commission lifted the wartime ban on all amateur radio bands.

Procurement contracts for the proximity fuze totalled $450 million for the year. Its cost had dropped from $732 each (1942) to $18 each (1945).

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Because World War One was fought on a global scale, the development of long-distance radio communication was vital to both sides. This review appeared in a British Marconi publication, so it gives a generally one-sided view of events, but it does document the importance of radio to both Great Britain and its German adversary.

The Yearbook of Wireless Telegraphy and Telephony, 1916, pages 625-644:

WIRELESS WAVES IN THE WORLD'S WAR.

A General Survey of War-Happenings affecting Radiotelegraphy.

By H. J. B. WARD, B.A.

"The value of Wireless Telegraphy may one day be put to a great practical and critical test; then perhaps there will be a true appreciation of the magnitude of our work."

THE words quoted above occur in a speech made by Senatore Marconi in the summer of 1914. Viewed in the light of recent events, they rank not merely as prophecy, but as fulfilled prophecy. The distinguished Italian referred to this fact in his address to his shareholders on July 26th last year.

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At 5 a.m. on July 30th, 1914, the great naval review at Spithead over, the first fleet, which had just left Portland, was recalled by wireless telegraphy and instructed not to disperse for manoeuvre-leave, as had been previously arranged. On the following Sunday, August 2nd, the *London Gazette* issued a special notice that it had become "expedient for the public service that His Majesty's Government should have control over the transmission of messages by wireless telegraphy."

The first National Service.

It will be seen therefore that five days before the actual declaration of war wireless telegraphy had performed its first national service, and that two days in advance of hostilities the British Government had taken steps to assume complete control of this all-important factor in national organisation. Two further notifications followed closely, both issued on August 3rd: the first providing for the dismantling of all wireless apparatus on merchant vessels in the territorial waters of the United Kingdom and Channel Islands, and the second ordering the closure of all experimental wireless telegraphy stations in this country, and asking for the co-operation of the public in order to secure "information of any wireless station which may be observed to be kept up in contravention of his orders."

Thus early did the British Government assume State control of Radiotelegraphy and take steps to ensure the complete cessation of its use by any private individuals in the country.

Of course, enemy installations were subsequently discovered here and there, and a few instances leaked through into the Press. But in by far the greater number of cases such matters were dealt with *in camera*, and information was very properly prevented from reaching the ears of the enemy.

This state of affairs has continued ever since; successive regulations have only tended to render the provisions more stringent, and to stop any loopholes for evasion which the wording of the proclamations

might appear to have left open. Englishmen, unaccustomed to interference with their private liberty, were slow to grasp the necessity for obeying absolutely and without question the Government regulations. Nevertheless here and there we find individual instances when men made spontaneous sacrifices for the benefit of their country in advance of anything demanded of them by Government. A notable example was shown by Mr. G. D. Smith, an English wireless operator on the German freight steamer *Mazatlan*, who, on October 7th, 1914, when ordered to communicate with the German cruiser *Leipsic*, for which his vessel was conveying a cargo of coal, wrecked the wireless apparatus rather than lend any aid to the enemy. Doubtless Mr. Smith's example found many emulators in similar emergencies; but the disregard for regulations, characteristic of the English under the humdrum conditions of home life, led many young amateurs into the courts, and all through the earlier months of the struggle a crop of wireless cases had to be dealt with, despite the solemn words of warning addressed to wireless amateurs in the pages of the *Wireless World* and other technical and non-technical journals.

Patriotic Duty.

It is hard--and no one but the person interested can know how hard--to have spent much time and labour in manufacturing and getting to work a set of apparatus only to find that war breaks out and one is asked immediately to dismantle it. But this is one of the sacrifices that wireless amateurs in England have been called upon to make, and on the whole, with a relatively small number of exceptions, they have made it, not grudgingly, but cheerfully and without reserve.

Aye, and more than this! They have consummated their sacrifice of amateurism by assuming the *rôle* of professionalism. Thus a very large number of young men, who in days gone by took their initial steps in radio training as amateurs, have now proved the value of their hobby, and to-day are performing useful service *pro patria*.

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Within the Empire the first steps of assumption and repression were speedily taken; the matter of wireless outside the Empire, however, was less simple. Naturally, as far as enemy wireless is concerned, the obvious and only course was destruction. The success with which this has been conducted is dealt with elsewhere. In the countries of our Allies the situation was equally plain and straightforward. There, Radiotelegraphy was, and is, as much under friendly influence as if it were directly controlled by our own Government. But when we come to neutral countries, affairs stand on a totally different basis. The situation has been complicated by (*a*) the various interpretations put upon neutrality by the Governments of the different countries; (*b*) the amount of influence obtained in peace-time by the German Government through their state-aided pseudo-private erection of stations; and (*c*) the amount of control exercised by the responsible neutral governments over outlying portions of their territories.

Neutral Wireless.

Take, for instance, the case of South America. In the earlier days of the War a correspondent, writing to the *Morning Post*, pointed to the large number of stations scattered through Argentine, Brazil, Chile, Uruguay, Paraguay, Peru, Ecuador and Colombia, emphasising that with regard to a large number of them there were potentialities of use inimical to the Entente.

Let us hasten to say that one and all of the *Governments* concerned have adopted the most correct attitude all the way through. A lengthy official statement on the subject was promulgated in the House of Commons on November 25th, 1914. Moreover, full advantage has been taken of the parental authority of "Uncle Sam" over the daughter republics in the Southern Continent, so that the difficulties with which the British authorities have had to contend in South America have been due rather to the surreptitious influence exerted by Germany than to the official attitude of neutral Governments. Germany backed her wireless industry in the same thorough manner as that in which she supported other Teutonic commercial enterprises. This is what was meant by her policy of "peaceful penetration." The result was that the Kaiser's Imperial Wireless chain was supplemented, notably in South America, by a number of commercial stations, the vast majority of which were

"Peaceful

Penetration."

constructed by Germans. This preference for the Teuton was partly a matter of "buying in the cheapest market," partly a matter of "pushfulness" displayed by diplomatic representatives and partly due to the support of German banks. Thanks to Government subsidies, German prices for wireless stations for a good many years antecedent to the War had been appreciably lower than those of her competitors. The combination of absurdly cheap contracts with expressly designed mechanical or electrical complications in wireless plants was supplemented (as a necessary corollary) by the introduction of the German "Wireless Expert." The latter was consistently found to be the only person who could efficiently work the station, and--as a result--in a large number of cases received a request to stay on in charge at a handsome salary. By such means as these "a very large number of the South American coast stations came under the charge of naturalised Germans, whilst in some cases the chief technical officials of the various Government telegraph administrations belong to the same nationality." [See an interesting paper on this subject specially contributed to the *Wireless World* by an engineer, resident before the war in South America.]

An incident which recently came to light through the arrival at San Francisco of a British scientist and his wife from a three years' archæological voyage gives an excellent illustration of the matter we are considering. Mr. and Mrs. Routlege were on Easter Island, conducting their scientific investigations,

Surreptitious Wireless.

when they witnessed the arrival of German cruisers and the erection by them of a base of supplies and a radiotelegraphic signalling station. This for a long time escaped notice because of the remoteness of the island from intercourse with the outside world. It is under the jurisdiction of Chile, but Chilian neutrality unsupported by Chilian armed force was treated with the usual Teutonic nonchalance.

The influence that this surreptitious wireless policy has had upon the course of the war is admirably illustrated by alternate victory and defeat. The only important German naval victory occurred on November 1st, 1914, in the Pacific, when Admiral Sir Christopher Cradock was defeated, and lost the *Good Hope* and *Monmouth*, a disaster gloriously avenged in the South Atlantic on December 8th of the same year. In the former instance the German success was undoubtedly due to the fact that they were within a wireless zone of activity friendly to themselves, so that they received knowledge of every movement of the British vessels at the moment of its initiation, whilst their own evolutions were concealed from the British, whose commander could only rely upon the installations on his own vessels.

A totally different state of affairs came into play when the German admiral, issuing from this zone of friendly wireless influences, made his abortive attempt to strike at the heart of the British friendly wireless zone centring round the Falkland Islands station. Beaten off by the British guardship, Von Spee's only resource for preventing the British from reaping the benefit of the information gained for them by the land station lay in a resort to jamming, and the operator at Port Stanley thus describes his frantic efforts:--

> "Immediately we touched the key, all the Germans pressed their keys, making indescribable noises by altering their spark frequencies rapidly. It has never been my lot to receive through such a jingle before, and I trust never again. *Our signalling continued without interruption despite their efforts*, although for about two hours pandemonium reigned in the ether."

It would have been impossible for Admiral Sturdee's great cruisers, the "Indomitable" and "Inflexible," to have made their long voyage, and reached the scene of action totally unknown to the German commander, had it not been that the latter, as soon as he left the Pacific for the Atlantic, had passed from his friendly wireless zone.

The Falkland Islands engagement not only exemplified in a most striking mariner the importance of wireless telegraphy, but has contributed one of the most dramatic British naval incidents which have occurred in modern days. Following the example of Nelson before the opening of the Trafalgar fight, but

utilising modern instead of ancient methods of signalling, Admiral Sturdee caused the message, "God Save the King," to be radiated from every wireless aerial in his fleet as the vessels went into action. There is as true a Nelson touch in this regard for dramatic effect as there was in the secret rush from England to avenge the honour of Britain's Navy upon her barbarous foe.

As an example of the cunning exercised by the Germans in pursuing their policy of secret world-wide wireless, we may refer to the report of a member of one of the naval expeditions engaged in "rounding up" the German Pacific colonies. He lays special emphasis upon the fact that they were constantly finding wireless installations in the most isolated and out-of-the-way places. In some cases they had to penetrate 50 miles into the interior before discovering the enemy wireless apparatus, artfully concealed amongst the trees.

World-wide Duplicity.

Not content, however, with exercising their underground ramifications in these out-of-the-way districts, the Germans went the length of tampering with the great American Republic itself. The story of Sayville Station, the ramifications of the German plot, its discovery, and the way in which the damning evidence was brought to the notice of, the United States authorities, constitute as thrilling a detective yarn in real life as could possibly be imagined by the brain of a Gaboriau or Edgar Allan Poe. Mr. Charles E. Apgar, the hero of the piece, has told the story in the American and British Press. This American wireless amateur displayed in sober actuality all the resourcefulness and ingenuity attributed by Sir Arthur Conan Doyle to his fictional hero, Sherlock Holmes. What, in effect, Mr. Apgar discovered was that, thanks to the German controllers of this station, secret messages, which would not have passed the Censorship established by the American Government, were communicated by an ingenious and scientifically worked-out system of transmission. As soon as these facts had been proved to the satisfaction of the United States President, he confiscated the station, and Commander W. H. G. Bullard assumed control. The incident is now closed, but its record of duplicity and impudent disregard of neutrality remains,--a flagrant example of the extreme length to which Teuton cunning is prepared to go in its bid for world-domination.

A note of irony is introduced by the fact that the regulations governing international wireless relations thus continually set at naught by Germany were framed by the Berne Convention, a permanent tribunal, whose inception was due to the initiative of the German Government, whilst the predominating voice in that Convention has, up to the declaration of war, been that of Germany. It was on the initiative of the German delegates that the old signal of distress, "CQD," was abolished by that Convention in favour of the modern "SOS." The Hun has as consistently violated the international law of neutrality as he has that of belligerency, and in so doing has aroused the resentment of many nations whose inclination it was to remain strictly aloof, if not to exercise a neutrality beneficent to the Central Powers. Only the other day, for instance, the Swedish Government was obliged to order the forcible sealing of the wireless fitments of a Hamburg-American liner lying in one of their own ports, on account of its commander having set at defiance the Swedish neutrality regulations which directed that wireless installations on all steamers should be dismantled whilst within Swedish territorial waters. This Hamburg-American liner had been utilising its wireless to the full, sending and receiving messages as though upon the high seas.

The German Delegates.

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We started these remarks with a quotation from the words of Senatore Marconi, and we would here refer to the comment he made upon his own prophecy a year after it was first uttered:--

> "I have full confidence that when the War is over, *and the facts can be made public,* the appreciation to which I have referred will not be lacking."

The old proverb that "A cat may look at a king" emboldens us to deprecate the Senatore's "gloss," and to point out that popular appreciation of the debt that all the combatants owe to wireless has already made great progress, so that whilst for *full* appreciation we may have to wait until the end of the war,

even the facts which have already been permitted by our censors to appear in the pages of the Press have sufficed to give some indication of what that indebtedness is.

Public Appreciation.

War is a science and, like any other branch of science, possesses its own machinery and implements. Of these, in every branch, our adversaries were better provided than ourselves and our Allies. Just as they were better furnished with men, with guns, with ammunition, with air-craft, and with transport, so had they grasped to a greater extent the military advantages afforded by the use of portable wireless apparatus. Gradually, painfully, step by step, the Allies have been obliged to overtake them, and not until this overtaking has been completed in every particular is it possible to look for that complete smashing of Prussian military ascendancy which can alone satisfactorily end the contest.

Mr. Godfrey Isaacs, in his inspiring speech of July 1915, emphasised the enormous amount expended by the German Imperial Government upon their wireless chain, and the excellent investment that this expenditure had proved to be. He demonstrated that by its means thousands of valuable German ships had been able to seek safe internment and escape otherwise inevitable capture by the British fleet.

The same theme of admiration for German preparedness formed the *motif* of the speech made by the Secretary of State for the Colonies when in the autumn of last year he introduced his report on the Colonial vote. Mr. Bonar Law declared that one of the first objects of military importance before the British and their Allies consisted of the capture or destruction of Germany's Colonial wireless stations. All through the overseas campaigns, which have resulted in the capture of German colonies one by one, until only East Africa remains to them, the objective of the allied attack has invariably been the great German wireless station in the respective districts. The capture of these installations has in each instance marked the decisive issue of the Allies' operations.

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Turn we now from the long-distance stations to the portable apparatus and field sets which keep the various units of an army in close touch with one another, and with their central authority. Naturally, the

Enemy Wireless in the Field.

German military authorities will not allow details of the working of such apparatus as this to leak through into our possession. But every now and again we get glimpses of them, and it is not long since there was published in the Press of one of the neutral countries an interesting account of how the reports of the smaller units were wirelessed first to divisional headquarters, and afterwards to main headquarters, being finally despatched thence to the High Command itself. The journalist who gave the account, apparently from details personally demonstrated or communicated to him, emphasised the admirable thoroughness of the system and its methodical working.

With regard to the enemy, however, we shall really have to wait until the end of the War before we can properly appreciate their indebtedness to wireless in field operations; at present it is largely a matter of knowing the preparations they had made and of judging their efficiency by the results.

But with regard to our own and our Allies' indebtedness, we are in a better position. One of the most interesting references to wireless working in the field appeared in a Press account of King George's tour round to the British forces in France and Flanders. After inspection of some of the motor-cyclist

British Field Radio Activities.

despatch riders, His Majesty paid a visit to the Army Signalling Head Office. This spot constitutes the nerve-centre of the army in the field, the central point of the spider's web. The tracery of the web is formed by the threads of messages ceaselessly passing to and fro, not only from every part of the sphere of action, but also from the bases of supplies in England. All methods of transmission are employed, and the total number of messages of all natures, and from all quarters, handled in one day, averages no fewer than 3,000, the majority of which run to a far greater length than the average telegrams of peace-time. What proportion of these messages is due to wireless telegraphy we are not in a position to say; nor should we be allowed to say it if we were. There is little doubt, however (not from conjecture but from actual indications of

fact), that radiotelegraphy bears its full share of this burden.

All sorts of odd little incidents happen in connection with field service work. An account extracted from a letter of a telegraphist in charge of a tiny little outpost station on one of the fronts came recently under our notice. It was only a little wooden hut, just large enough for two, yet the telegraphist states that he was in regular receipt of the French *communiqués* from the Eiffel Tower, the German fairy-tales from the enemy long-distance stations, and occasionally of messages from Madrid. It seems strange that the occupant of such a tiny outpost cabin should be able to gather the wireless news before it becomes known in the great world-centres.

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Wireless on Aircraft.

Aircraft and wireless have between them revolutionised the whole system of military scouting. A most interesting picture recently went the round of the British Press, showing a group of Frenchmen, some with the double wireless ear-pieces fitted close to their heads, others standing by with note-books ready to take down messages dictated from oral reception, whilst one keen-visaged Frenchman keeps his hands hovering significantly over the transmission keyboard. Pictures make an eloquent appeal, in a way impossible to mere verbal description, and such an illustration brought home very vividly to newspaper readers the method in which the scouting work at the front is done. Hovering high in the air, French aeroplanes were viewing the enemy preparations against the Salonika position, and transmitting the results of their operations to this group of signallers.

The aircraft utilised for this kind of observation may be of many descriptions, and practically all forms are being used in the present war: dirigibles, both rigid and non-rigid; observation balloons; and aeroplanes. All, however, have this in common--that their utility depends upon the rapidity, not only of their observation, but also of their transmission of what they have observed. They must, moreover, do their work under all conditions of weather, and wireless alone furnishes a means practically instantaneous in transmission, and capable of serving its purpose in sunshine and fog, in the still atmosphere of a summer day, or through the fierce blasts of winter storms.

Over and above the province of scouting, however, the recent development of fleets of battle-planes composed of "Dreadnoughts of the air" in combination with smaller and swifter "cruisers" and "destroyers" operating as a complete fleet entity, has been rendered possible by the aid of wireless.

Arising out of their efficiency in scouting work, and supplementing this branch of activity, aeroplanes are now regularly employed in the direction of gunfire. By dint of following out the directions given by wireless from these aerial "Watchers," the great cannon now regularly employed on land and sea can actually bombard points totally invisible to the manipulators of these mighty engines of war.

The wonderful accuracy with which it is possible to direct gunfire by wireless from aeroplanes is exemplified in a communication to a friend at home from an operator on one of H.B.M.'s men-of-war. He narrates how, at a time when the vessel on which he was employed was engaged in shelling a town on one of the Eastern sea-boards, a central feature of the city consisted of a mosque tower erected on a piece of high ground. Anxious to set the Germans a good example, the aeroplane operator so directed the gunfire which he controlled that, despite the fact that shells from British vessels destroyed everything in and around the place, the mosque tower remained intact.

Aircraft of the Zeppelin type carry installations as a matter of course, and their lifting capacity enables them to support apparatus capable of reception and transmission over much longer distances than their "heavier-than-air" comrades.

Wireless stations are provided at all the airship bases on the German frontiers, and what a Zeppelin, properly equipped with a wireless transmitter and receiver, can accomplish may be gauged from the fact that in 1913, during the Upper Rhine reliability trials, the old "Victoria Louisa," which took part in them, remained throughout their duration in constant wireless communication with the base at Frankfort over a distance of 120 miles, besides communicating with other stations up to 200 miles; so that a complete

and regular wireless service was maintained for the benefit of her passengers.

We do not know as yet what the far more powerful installations on the later type of Zeppelins are capable of; but of this we may feel sure, that they certainly have doubled the distance obtained by the older type.

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We have hitherto been dealing for the most part with land warfare; but, after all, the greater pride of the British Empire rightly centres in her fleet, and the indebtedness of the Fleet to wireless telegraphy is even more pronounced than that of the shore forces. Here there are no competing methods of transmission, and wireless rules alone.

Wireless in the "Senior Service."

We referred at the beginning of our article to the wireless message which instructed the Fleet assembled for review to remain "in being," and assured Great Britain against the "hussar stroke" which the "All Highest" used to boast he held in store for the British at sea.

Details are necessarily and rightly lacking; but the main outlines are clear enough. One of the first notable accounts of what was going on was afforded by the American journalist, Mr. Frederick Palmer, who, in September 1915, was favoured with a personally conducted tour round the "Grand Fleet" of Britain. The description of what he saw on the Flagship of Sir John Jellicoe is worth quoting *verbatim*. After picturing for his readers his first glimpse of the British admiral, "rarely without a telescope under his arm," the American was conducted through the Flagship, and finally into the little cabin which forms the hub of the mighty organisation:--

> "Stepping into a small room where the telegraph keys clicked and a compact wireless apparatus was hidden behind armour, we saw one focus of communication which brings Sir John word of any submarine sighted, or of any movement in all the seas around the British Isles, and carries the Commander-in-Chief's orders far and near. The bluejackets on this service are invariably sturdy, long-service men of mature years."

dates?

Think of what this picture means! Nelson and the great British geniuses of the sea in old days were able to communicate with the units of their fleet by flag and flare signals alone, visible only when they were in close proximity to the Admiral's ship, and when the state of the atmosphere was favourable; liable to misunderstanding at all times. Many and many a battle manoeuvre, ordered under those old conditions, failed in execution through non-reading (or mis-reading) of the primitive signals employed. Whenever a squadron had to be detached for separate service; as the vessels composing it passed from view, they passed from all possibility of quick communication. They might be able to carry out what they were sent to do, or they might fail. They might be destroyed, or sail away in a wholly unintended direction, without being able to let their commander-in-chief know where they were, or what they were doing. Wireless has completely revolutionised all this. Admiral Jellicoe can despatch single ships, or squadrons, where he will, and remain in touch with them the whole time. They can tell him how they fare, what they discover, how they are acting; they can ask for his instructions and receive them, so that he always has them as truly under command as if they were lying within earshot close by his side.

The complicated manoeuvres of a modern fleet are only possible under such conditions. The "traffic," as it is technically called, at headquarters is enormous. The Lieutenant-Commander in charge of signals has information poured over him without cessation. Sheaves of white forms intrude upon his plate as he sits at table, are thrust into his hand as he goes on deck, follow him wherever he is in the ship, and fill his cabin. Only the Admiral and the Paymaster, who acts as the Admiral's secretary, can guess the vast mass of detailed information, instructions, and routine connected with the squadron with which they daily wrestle, even when the enemy makes no attempt to bring them to action. "Stupendous" is the only word which can adequately describe the paper work alone. This goes on without cessation; the British fleet is on active service all the time. Senior officers in peace time do occasionally enjoy a little leisure;

under present war conditions they get none at all. And this is the work of wireless.

A very excellent description by a writer who had been serving with the Grand Fleet appeared in the pages of one of the principal London dailies describing "A Wonderful Night for Wireless." The writer, who appears to have been an expert radio-telegraphist, describes how he listened to the various messages which were simultaneously quivering through the ether, but at different wave-lengths, and which accordingly could be picked out singly, by due adjustment of the receiver. He summarises: "We heard the Russian commander-in-chief in the Baltic; we heard Madrid; we heard the German commander-in-chief from his fastness across the North Sea; we heard the British Commander-in-chief in the Mediterranean; we heard Norddeich and Poldhu."

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We have already referred several times to Horatio Nelson. It is scarcely possible to write, or even to think for any length of time, concerning the British Navy and fail to turn one's thoughts to our eighteenth-century naval hero, so thoroughly does he typify the spirit of the "Senior Service." His statue, perched high on top of the lofty column stationed in Trafalgar Square, looks down upon the roofs of the Admiralty. Those roofs are criss-crossed with wires, which are constantly busy. Day and night they are actively picking up messages from the Grand Fleet and from all quarters of the globe; day and night they transmit information and issue orders.

The Naval "Nerve Center."

As you pass down Whitehall, or cross the Horse Guards Parade, you must often have noticed folk pointing out the aerials to one another. None but a feeble imagination can fail to be thrilled by the thought of what those wires could tell us if they were at liberty to speak. Here we are at "the heart of things," the "nerve centre" of the British Navy. It is on these palpitating wires that Lord Nelson's figure looks. An inspiring picture on the subject was published by the *Sphere* towards the end of last year under the title of "England Expects . . ." There is something peculiarly appealing in the close association between the colossal present and our glorious past. The same sight, too, has moved *Punch* to pen the following Gilbertian lines:--

"There sits a little demon
Above the Admiralty,
To take the news of seamen
Seafaring on the sea;
So all the folk aboardships,
Five hundred miles away,
Can pitch it to their Lordships
At any time of day.

* * * * * *

We have been speaking up to the present of British naval wireless, as in duty bound, for on the sea at all events Great Britain claims "Pride of place." Our British sea-dogs have provided that the moment the Germans show themselves outside their own safe waters, wireless shall flash news to Britain's naval commanders, so that Jack may be ready to receive his Teuton foe ere he can issue from the narrow waters and range in battle array.

Enemy Naval Wireless.

Wireless has been of invaluable use for aggressive purposes to the various German naval raiders which have preyed upon our merchant traffic. The latest of the German corsairs, the so-called *Möwe* after she had taken a number of British prizes and put the survivors on board the *Appam*, despatched the latter vessel to America, with strict directions to receive all wireless messages and be guided by them, but to send none. The same procedure seems to have been largely followed by the *Kronprinz Wilhelm* during her course of piracy. We have read extracts published from the diary of Paymaster Mahlstedt, who formed part of her personnel, and find that he attributes to this policy the

immunity his ship enjoyed for so many months. Our German diarist evidently believes that it is possible to have "too much of a good thing"--even wireless!

A striking demonstration of the confidence inspired in the mercantile marine by the possession of wireless occurred when the S.S. *Nebraskan*, an American steamer, was torpedoed off the Irish coast. The torpedo exploded in the forward part of the vessel, and the steamer appeared to be settling by the head. The crew took to the boats, while the wireless operator set to work with the S O S signal. The boats hovered near the vessel, and, as nothing further seemed to happen and there were no signs of her sinking further in the water, they returned to their ship, which was ultimately manoeuvred under her own steam into Liverpool. This result was due to the confidence inspired by the fact that, through wireless telegraphy, it was possible to communicate and ask for help at any time. Many a steamer unprovided with such safeguarding apparatus has been abandoned by her crew, and left to drift helplessly to and fro at sea, useless to her owners and dangerous to other vessels.

Wireless in the Mercantile Marine.

And not only has wireless helped merchantmen by enabling them to signal for aid; it has likewise enabled them to receive messages warning them of the existence of danger. At the very outset of the war, one dark night in August, the *Mauretania* received a message from H.M.S. *Essex* bidding her change her course and make for Halifax. She obeyed--so suddenly that the passengers on board thought the vessel was going to turn turtle--blanketed all her lights and arrived safely. Thus also were the *Cedric*, the *Calgarian*, and many another vessel saved from the depredations of the German raiding cruisers in the early days of the struggle.

Timely and other Warnings.

Such warnings as these, however, must always be taken *cum grano salis*, a point very clearly brought out in an incident which occurred in the early part of the current year in the Mediterranean Sea. The liner *America* was on her way from New York to Naples, and had on board that which would have been sadly missed by the British forces had it not got through. Soon after she left Gibraltar her wireless operator received a message directed to the captain instructing him to change his course and steer for a certain rendezvous, where he would be joined by an escort. The message in question purported to come from Algiers, but the wireless operator, a man of experience, seemed to "suspicion" that all was not as it seemed. Perhaps he knew the peculiar note which is, or was, characteristic of the Algiers Station. Anyhow, his technical knowledge led him to believe that the message seemed to emanate from a point much nearer. He reported his suspicions to the captain, who, acting on the advice, carefully avoided the course recommended by this, as it turned out, *fake* messages from an enemy submarine, and reached Naples in safety. Such instances might be multiplied indefinitely, but we will close this section with a passing mention of the dramatic incident narrated by one of the partcipators in the event. A "Pacific Steam" liner was wirelessly summoned by the *Karlsruhe* to give her exact position, and through the same medium declined to do so, and breathed defiance Fortunately concealed by fog, the British vessel felt her way, directing her course in accordance with the strength of the wireless signals, and passed the German raider some ten miles abeam! Could fiction depict a more dramatic example of the direct utility of wireless to non-combatant ships in times of war?

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Perhaps one of the most striking points in connection with wireless which has been developed by this war is that public attention has been directed upon it as never before, owing to the fact that so much of the official information--particularly enemy information--has been brought to the notice of newspaper readers through this medium.

Wireless War Bulletins.

And here we may advert to the curious psychological fact of the inveterate anthropomorphism of the "man (and woman) in the street." We have had all sorts of moral attributes attached in public phraseology to wireless. What more common heading do we find in the Press than "German Wireless Lies," or "More Wireless

Mendacity." We have even noticed in heavy block type the heading, "Wireless Blasphemy!" If one sits down to analyse, even for a moment, such phraseology, its stupendous inappropriateness is immediately apparent. Wireless--as wireless--never lies. But inasmuch as this magnificent instrument, like all other instruments equally potent for good or evil, is frequently wielded by the wicked, the messages transmitted on their initiative embody the characteristics of the senders' immoral nature. This truth is crystallised in crisp, anthropomorphic phrase, analytically and philosophically incorrect, but nevertheless containing an essential underlying truth.

Objects.

We have referred frequently elsewhere to the fact of Germany's cable isolation, and her consequent dependence upon wireless. She wants to conduct a propaganda campaign in neutral countries. She yearns to magnify her military successes, to minimise her defeats, to excuse the deeds of infamy which have caused her reputation to stink in the nostrils of the civilised world. She desires to issue vapouring boasts about what she is going to do, and to disseminate communications of her future intentions, wherein falsehood and truth are so mixed up as to render it hard for the military and political directors of the Allies to utilise the information to her detriment. For all these purposes, she has been obliged to place her main reliance upon radiotelegraphy. The ether is daily and nightly filled with messages sent from Norddeich, Hanover, Cologne and other long-distance stations, some presciently erected in times of peace, some put up since the beginning of hostilities. These various communications are picked up by the wireless installations of the Allies, and, as far as the British Press is concerned, are issued for publication (after censorship) by the "Wireless Press," which thus discharges a highly valuable public duty.

They may be roughly divided into two categories (*a*) official reports of military events on the various fronts issued under the supervision of German headquarters, and (*b*) political propaganda of various kinds, slanders against their enemies, and a certain amount of more or less garbled news about internal affairs in Germany, particularly emphasising the speeches made and debates carried on in the German Reichstag.

Methods.

With regard to the military headquarters reports, these have, on the whole, been characterised, as far as the purely German operations are concerned, by a fair accuracy as to the facts narrated, relying for their favourable effect rather upon the *suppressio veri*--turning a blind eye to adverse facts and only narrating favourable--combined with a large amount of *suzggestio falsi*, which generally takes the shape of insinuating the false conclusion by the verbiage employed. For instance, over and over again a fierce German attack has resulted in the capture of some Allied trenches, and the German report duly embodies this capture, conveniently omitting to state that an Entente counter-attack had been successful in causing them to revert to their former owners. A fair instance of the *suggestio falsi* occurred when they announced that their fierce onslaught upon Verdun at the end of February was marked by the capture of Douaumont, an antiquated piece of fortification which had been entirely undefended--as a fort--by the French, but which the German headquarters account characterised as "the armoured fortress of Douaumont, the north-eastern pillar of the permanent main line of fortifications of the Verdun fortress."

The political and propaganda *communiqués* are of a totally different nature. They consist almost entirely of a tissue of misrepresentations, lying insinuations, and direct falsifications of the truth. For instance, soon after they had captured Brussels they set to work to carefully search the confidential files of the Belgian Government for evidence which could be twisted into a "rod" wherewith to "beat the backs" of the British. Of course, they unearthed a number of communications which had passed between Belgium and the British War Office and Foreign Office. These, after careful selection and doctoring, they published in order to support their monstrous accusation against Great Britain, that she had been for years preparing an attack upon Germany, in which she was to receive the assistance of the Belgian Government, and for which purpose she had arranged to ignore all treaties of Belgian neutrality. These baseless and belated accusations fell a little flat after the deliberate acknowledgment in the Reichstag

made by Count von Bülow that Germany had committed a "technical error" in violating the Belgian treaty and tearing up "the scrap of paper," but pleading that they had been obliged to do so by *force majeure*. On several other occasions the German wireless propagandists persisted in spreading lying statements about "British misuse" of hospital ships. They tried to make out that these vessels, protected by the Geneva Convention against armed assault, were being utilised in large numbers by the British Government for the conveyance of troops and munitions of war. The slander was repeatedly and categorically denied by British Ministers, but it was, over a long period of time, kept up, added to, and repeated through the wireless stations controlled by the German Government.

Naturally, their idea in continually promulgating these glaring falsehoods was intended to excuse the flagrant breaches of international law both past and in contemplation. Moreover, Mr. Teuton has always acted upon a belief in the ancient adage, "Only throw enough mud, and some of it is sure to stick!" They have not attained their object. What they *have* succeeded in doing is to establish for themselves such a reputation as has never been the lot of any responsible Government of a civilised nation. It will doubtless be within the recollection of some of our readers that on one occasion they actually added to their wireless *communiqué* the words "das ist die wahrheit" (*this is the truth*). Can anything be more humiliating than for the official communication of a first-class Power to be reduced to begging to be "believed *this* time"? It is a notable instance of "the engineer hoist with his own petard."

Results.

The Allies, in their turn, have systematically utilised wireless for the purpose of radiating reports received from the various fronts; and, although to a comparatively limited extent, have endeavoured to neutralise the effects of German "poison gas" by the antidote of truth. Mistakes may have occasionally been made, but they have always been honest mistakes, and by far the greater part of the Allies' endeavours has been devoted to demonstrating to the world at large the baseless character of the slanders levelled at them by their malignant opponents.

In the course of the egregious account recently sent forth by a German of some repute concerning the escape of the *Goeben* and *Breslau* from Sicily through the Golden Horn, the *deus ex machina* is made out to be German wireless. This impudently mendacious story alleges that, becoming aware of wireless messages being sent by the British scout concerning the change in the German warships' course, which indicated their real destination, the word went out from the Teutonic admiral, "Jam the British wireless, jam it like the devil." According to this modern Niebelungenlied, Telefunken absolutely crushed Marconi; the news failed to reach the British Admiral in time, and thus two formidable units were duly added to the Ottoman Navy. Doubtless our disingenuous German fabulist intended to prefigure, by this combat of ether waves, the result of the ultimate issue of the whole war. The same kind of prophecy, however, with wireless as a prototype of the protagonists, appeared in the pages of *Punch* from the pen of "Evoe" in the early days of warfare. Here, as may easily be judged, the victory lay in another quarter, and unmistakable signs are already visible upon the horizon pointing to the fact that this prefiguration is the correct one. "Evoe's" lines appeared under the title of an "Ode to the Spirit of Wireless Victory," and dealt with the rout of Telefunken and its complete subjugation by the radiant waves of Marconi. It is significant that each side should choose the spirit of radio-telegraphy to represent its general cause. "Evoe's" lines run thus:

. . . . "red devastation
Still shall urge by land and sea
Every proud advancing nation,
While Marconi's installation
Rules the skies of Germany."

- United States Early Radio History > Radio During World War One

BOOK OUTLINE

tracks 32 - 39

September 6, 2006
Track 32

This book is about the development of electronic communications over the course of the twentieth century and what it means for us today. How did it come into being? How did it get where it is? What's going on? What drives electronic communications? And what does this evolution mean about how to think about new developments in the industry? This is an important topic to understand now as the internet and its regulation evolves.

I realized the importance of this subject at a recent conference. [What was the conference about? Who / what types of people attended?] There, we had a discussion of net neutrality, which is a complicated concept, but basically means that the phone companies, the cable companies that are providing internet services, have to treat all users of the internet the same. For instance, Cox cable can't put on an internet service and give their own service favorable treatment compared to someone else. In other words, they can't tell their internet subscribers that they can't use Vonage or Skype for telephone because Cox provides the telephone. The term for that has come to be net neutrality. It sounds like a good thing, but if you know something of the history of the regulation of television and telecom, you become very worried that that simple minded idea is the camel's nose under the tent for the government to regulate the content – what is a telephone service? Who does what? What is a television service? If you're going to be neutral, the government has to tell you how to be neutral, and it just cascades. The people at this internet conference thought that, yeah, the government ought to regulate net neutrality without realizing that it has an adverse impact for their business. They seemed not to understand that what they were doing was riding atop an infrastructure that's highly competitive and allowed a tremendous amount of flexibility in developing new kinds of media, new kinds of services. They only had some vague idea that the government regulated all that.

I. Pre-Office of Telecommunications Policy

During the technology development phase of the early twentieth century, there was a lot of competition, a lot of confusion and debate about what these technologies [what technologies?] made possible and what they meant. [Illustrate what type of confusion and debates existed] It was a period of intense innovation as well as confusion, and there was a lot of excitement about it. [How do we know there was a lot of excitement? Why were they excited?]

A. Telephone

At the opening of the twentieth century, the Bell patents had expired, and the telephone industry was very competitive. There were just about as many Bell and non-Bell (independent) telephones. There was more innovation and growth in independents because in some ways they

had better access to capital because they could sell in small local chunks whereas AT&T was set up at that time as a national entity that raised its capital for its entire industry in one place.

During the next 20 years, Bell substantially consolidated its monopoly position. [How did that happen? How did we get from patent expiration and a competitive phone industry to a monopoly? What were JP Morgan and Theodore Vail's roles?]

1. Theodore Vail

The telephone business in the first 20 years is mostly about Theodore Vail, who became CEO of AT&T in 1907 and structured the Bell system. Vail was a systematizer. He believed in tight organization – every engineer had the same training materials and equipment everywhere across the country. [Other examples of tight organization would be useful] Decisions to expand were done in light of consistency. [What does this sentence mean?] Theodore Vail created the Bell system and made it a bureaucracy run by bureaucrats and enabled the company to deliver good service very well and become a very powerful entity. [How did his reorganization allow AT&T to become powerful? One doesn't necessarily flow from the other] AT&T basically provided better telephone service. They used that position to get the government to grant it preferential powers [such as?], which lead to the consolidation of their monopoly. So the telephone business is for the first 20 years substantially T. Vail.

B. Radio Broadcast

Radio as we know it didn't happen until 1920. There was a lot of innovation in wireless, a lot of excitement about wireless – first wireless telegraphy and then to some extent wireless voice – but wireless voice was thought of as wireless telephony. Everybody saw it as a way to provide telephone service without wires. For unexplained reasons no one really thought of radio as a broadcast medium. The thought of radio as a conduit for information and entertainment really just came out of the blue in 1920 and took off in a big, big way across the country starting in 1921.

In the radio broadcasting story, the three characters are HP Davis, Bill Paley, and Herbert Hoover.

1. H.P. Davis

The radio story is more complex than the phone story – there are a lot more actors. The first actor I think is the guy who I think really made radio – HP Davis at Westinghouse. Davis's story includes the development of broadcasting and consumer electronics business. [What is this story? Who is Davis? What did he do? How did what he did take off?]

2. Bill Paley

In the development of the networks, the characters are Owen Young at GE, Robert Sarnoff at RCA, and Bill Paley at CBS. I think the primary actor there is Bill Paley. The three stories here – radio, the development of the networks (not sure who the actors are there), and the development of advertising on the networks as we know it (Bill Paley) – carries us up to the early '30s, when the '34 Telecom Act which consolidates the structure of the radio broadcast business.

3. Herbert Hoover

Herbert Hoover is one of the most important guys. He provided the regulatory mechanism, which is in large part why there are three television networks. [When? What was the regulatory mechanism? How did it evolve?]

That's what we need to develop.

The stories come together in the 20s when AT&T tried to use its economic and patent position to create a radio / telephone monopoly, but for some reason, they failed. [Need to research this – the fact they tried, how they tried is in the books. But why they didn't succeed is not there. Tom thinks it's a story of politics, and it's probably part of the radio network story.]

WWI – patents, etc. – how did these come into play and why are they important to our story?

Movies – how did these come into play and why are they important to our story?

A new entertainment technology that became popular about the same time as radio — ditto phonograph somewhat earlier

Need to reconcile this stream of consciousness w/ the story outline.

"Touch Someone": The Telephone Industry Discovers Sociability

CLAUDE S. FISCHER

The familiar refrain, "Reach out, reach out and touch someone," has been part of American Telephone and Telegraph's (AT&T's) campaign urging use of the telephone for personal conversations. Yet, the telephone industry did not always promote such sociability; for decades it was more likely to discourage it. The industry's "discovery" of sociability illustrates how structural and cultural constraints interact with public demand to shape the diffusion of a technology. While historians have corrected simplistic notions of "autonomous technology" in showing how technologies are produced, we know much less about how consumers use technologies. We too often

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take those uses (especially of consumer products) for granted, as if they were straightforwardly derived from the nature of the technology or dictated by its creators.[1]

In the case of the telephone, the initial uses suggested by its promoters were determined by—in addition to technical and economic considerations—its cultural heritage: specifically, practical uses in common with the telegraph. Subscribers nevertheless persisted in using the telephone for "trivial gossip." In the 1920s, the telephone industry shifted from resisting to endorsing such sociability, responding, at least partly, to consumers' insistent and innovative uses of the technology for personal conversation. After summarizing telephone history to 1940, this article will describe the changes in the uses that telephone promoters advertised and the changes in their attitudes toward sociability; it will then explore explanations for these changes.[2]

[1]See C. S. Fischer, "Studying Technology and Social Life," pp. 284–301 in *High Technology, Space, and Society: Emerging Trends*, ed. M. Castells (Beverly Hills, Calif., 1985). For a recent example of a study looking at consumers and sales, see M. Rose, "Urban Environments and Technological Innovation: Energy Choices in Denver and Kansas City, 1900–1940," *Technology and Culture* 25 (July 1984): 503–39.

[2]The primary sources used here include telephone and advertising industry journals; internal telephone company reports, correspondence, collections of advertisements, and other documents, primarily from AT&T and Pacific Telephone (PT&T); privately published memoirs and corporate histories; government censuses, investigations, and research studies; and several interviews, conducted by John Chan, with retired telephone company employees who had worked in marketing. The archives used most are the AT&T Historical Archives, New York (abbreviated hereafter as AT&T ARCH), and the Pioneer Telephone Museum, San Francisco (SF PION MU), with some material from the Museum of Independent Telephony, Abilene (MU IND TEL); Bell Canada Historical, Montreal (BELL CAN HIST); Illinois Bell Information Center, Chicago (ILL BELL INFO); and the N. W. Ayer Collection of Advertisements and the Warshaw Collection of Business Americana, National Museum of American History, Smithsonian Institution, Washington, D.C. A bibliography on the social history of the telephone is unusually short, especially in comparison with those on later technologies such as the automobile and television. There are industrial and corporate histories, but the consumer side is largely untouched. For some basic sources, see J. W. Stehman, *The Financial History of the American Telephone and Telegraph Company* (Boston, 1925); A. N. Holcombe, *Public Ownership of Telephones on the Continent of Europe* (Cambridge, Mass., 1911); H. B. MacMeal, *The Story of Independent Telephony* (Chicago: Independent Pioneer Telephone Association, 1934); J. L. Walsh, *Connecticut Pioneers in Telephony* (New Haven, Conn.: Morris F. Tyler Chapter of the Telephone Pioneers of America, 1950); J. Brooks, *Telephone: The First Hundred Years* (New York, 1976); A. Hibbard, *Hello-Goodbye: My Story of Telephone Pioneering* (Chicago, 1941); Robert Collins, *A Voice from Afar: The History of Telecommunications in Canada* (Toronto, 1977); R. L. Mahon, "The Telephone in Chicago," ILL BELL INFO, MS, ca. 1955; J. C. Rippey, *Goodbye, Central; Hello, World: A Centennial History of North-*

A Brief History of the Telephone

Within about two years of A. G. Bell's patent award in 1876, there were roughly 10,000 Bell telephones in the United States and fierce patent disputes over them, battles from which the Bell Company (later to be AT&T) emerged a victorious monopoly. Its local franchisees' subscriber lists grew rapidly and the number of telephones tripled between 1880 and 1884. Growth slowed during the next several years, but the number of instruments totaled 266,000 by 1893.[3] (See table 1.)

As long-distance communication, telephony quickly threatened telegraphy. Indeed, in settling its early patent battle with Western Union, Bell gave financial concessions to Western Union as compensation for loss of business. As local communication, telephony quickly overwhelmed nascent efforts to establish signaling exchange systems (except for stock tickers).

During Bell's monopoly, before 1894, telephone service consisted basically of an individual line for which a customer paid an annual flat fee allowing unlimited calls within the exchange area. Fees varied widely, particularly by size of exchange. Bell rates dropped in the mid-1890s, perhaps in anticipation of forthcoming competition. In 1895, Bell's average residential rate was $4.66 a month (13 percent of an average worker's monthly wages). Rates remained high, especially in the larger cities (the 1894 Manhattan rate for a two-party line was $10.41 a month).[4]

On expiration of the original patents in 1893–94, thousands of new telephone vendors, ranging from commercial operations to

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western Bell (Omaha, Nebr.: Northwestern Bell, 1975); G. W. Brock, *The Telecommunications Industry: The Dynamics of Market Structure* (Cambridge, Mass, 1981); I. de S. Pool, *Forecasting the Telephone* (Norwood, N.J., 1983); R. W. Garnet, *The Telephone Enterprise: The Evolution of the Bell System's Horizontal Structure, 1876–1909* (Baltimore, 1985); R. A. Atwood, "Telephony and Its Cultural Meanings in Southeastern Iowa, 1900–1917" (Ph.D. diss., University of Iowa, 1984); Lana Fay Rakow, "Gender, Communication, and the Technology: A Case Study of Women and the Telephone" (Ph.D. diss., University of Illinois at Urbana-Champaign, 1987); and I. de S. Pool, ed., *The Social Impact of the Telephone* (Cambridge, Mass., 1977). (Note that AT&T, Bell, and similar corporate names refer, of course, to these companies—or their direct ancestors—up to the U.S. industry reorganization of January 1, 1984.)

[3]Statistics from AT&T, *Events in Telecommunications History* (New York: AT&T, 1979), p. 6; U.S. Bureau of the Census (BOC), *Historical Statistics of the United States*, Bicentennial Ed., pt. 2 (Washington, D.C., 1975), pp. 783–84.

[4]Rates are reported in scattered places. For these figures, see BOC, *Telephones and Telegraphs 1902*, Special Reports, Department of Commerce and Labor (Washington, D.C., 1906), p. 53; and *1909 Annual Report of AT&T* (New York, 1910), p. 28. Wage data are from *Historical Statistics* (n. 3 above), tables D735–38.

TABLE 1
TELEPHONE DEVELOPMENT, 1880–1940

	Number of Telephones	Telephones per 1,000 People	Percentage in Bell System	Percentage Independent, Connected to Bell	Percentage Residential, Connected to Bell
1880	54,000	1	100	0	...
1885	156,000	3	100	0	...
1890	228,000	4	100	0	...
1895	340,000	5	91	0	...
1900	1,356,000	18	62	1	...
1905	4,127,000	49	55	6	...
1910	7,635,000	82	52	26	...
1915	10,524,000	104	57	30	...
1920	13,273,000	123	66	29	68
1925	16,875,000	145	75	24	67
1930	20,103,000	163	80	20	65
1935	17,424,000	136	82	18	63
1940	21,928,000	165	84	16	65
1980	180,000,000	790	81	19	74

SOURCES.—U.S. Bureau of the Census, *Historical Statistics of the United States*, Bicentennial Ed., pt. 2 (Washington, D.C., 1975), pp. 783–84; and U.S. Bureau of the Census, *Statistical Abstract of the United States 1982–83* (Washington, D.C., 1984), p. 557.

small cooperative systems, sprang up. Although they typically served areas that Bell had ignored, occasional head-to-head competition drove costs down and spurred rapid diffusion: almost a ninefold increase in telephones per capita between 1893 and 1902, as compared to less than a twofold increase in the prior nine years.[5]

Bell responded fiercely to the competition, engaging in price wars, political confrontations, and other aggressive tactics. It also tried to reach less affluent customers with cheaper party lines, coin-box telephones, and "measured service" (charging by the call). Still, Bell lost at least half the market by 1907. Then, a new management under Theodore N. Vail, the most influential figure in telephone history, changed strategies. Instead of reckless, preemptive expansion and price competition, AT&T bought out competitors where it could and ceded territories where it was losing. With tighter fiscal con-

[5]BOC, *Telephones, 1902* (n. 4 above); Federal Communications Commission (FCC), *Proposed Report: Telephone Investigation* (Washington, D.C., 1938), p. 147. AT&T has always officially challenged this interpretation; see, e.g., *1909 Annual Report of AT&T*, pp. 26–28.

trol, and facing capital uncertainties as well, AT&T's rate of expansion declined.[6] Meanwhile, the "independents" could not expand much beyond their small-town bases, partly because they were unable to build their own long-distance lines and were cut off from Bell-controlled New York City. Many were not competitive because they were poorly financed and provided poor service. Others accepted or even solicited buyouts from AT&T or its allies. By 1912, the Bell System had regained an additional 6 percent of the market.

During this competitive era, the industry offered residential customers a variety of economical party-line plans. Bell's average residential rate in 1909 was just under two dollars a month (about 4 percent of average wages).[7] How much territory the local exchange covered and what services were provided—for example, nighttime operators—varied greatly, but costs dropped and subscriber lists grew considerably. These basic rates changed little until World War II (although long-distance charges dropped).

In the face of impending federal antitrust moves, AT&T agreed in late 1913 to formalize its budding accommodation with the independents. Over several years, local telephone service was divided into regulated geographic monopolies. The modern U.S. telephone system—predominantly Bell local service and exclusively Bell long-distance service—was essentially fixed from the early 1920s to 1984.

The astronomical growth in the number of telephones during the pre-Vail era (a compound annual rate of 23 percent per capita from 1893 to 1907) became simply healthy growth (4 percent between 1907 and 1929). The system was consolidated and technically improved, and, by 1929, 42 percent of all households had telephones. That figure shrank during the Depression to 31 percent in 1933 but rebounded to 37 percent of all households in 1940.

Sales Strategies

The telephone industry believed, as President Vail testified in 1909, that the "public had to be educated . . . to the necessity and ad-

[6]See, e.g., *Annual Report of AT&T*, 1907–10; and FCC, *Proposed Report* (n. 5 above), pp. 153–154. On making deals with competitors, see, e.g., Rippey (n. 2 above), pp. 143ff.

[7]*1909 Annual Report of AT&T*, p. 28. Charges for minimal, urban, four-party lines ranged from $3.00 a month in New York (about 6 percent of the average manufacturing employee's monthly wages) to $1.50 in Los Angeles (about 3 percent of wages) and much less in small places with mutual systems; see BOC, *Telephones and Telegraphs and Municipal Electric Fire-Alarm and Police-Patrol Signaling Systems, 1912* (Washington, D.C., 1915); and *Historical Statistics* (n. 3 above), table D740.

vantage of the telephone."[8] And Bell saluted itself on its success in an advertisement entitled "Blazing the Way": Bell "had to invent the business uses of the telephone and convince people that they were uses. . . . [Bell] built up the telephone habit in cities like New York and Chicago. . . . It has from the start created the need of the telephone and then supplied it."[9]

"Educating the public" typically meant advertising, face-to-face solicitations, and public relations. In the early years, these efforts included informational campaigns, such as publicizing the existence of the telephone, showing people how to use it, and encouraging courteous conversation on the line.[10] Once the threat of nationalization became serious, "institutional" advertising and publicity encouraged voters to feel warmly toward the industry.[11]

As to getting paying customers, the first question vendors had to ask was, Of what use is this machine? The answer was not self-evident.

For roughly the first twenty-five years, sales campaigns largely employed flyers, simple informational notices in newspapers, "news" stories supplied to friendly editors (many of whom received free service or were partners in telephony), public demonstrations, and personal solicitations of businessmen. As to uses, salesmen typically

[8]Testimony on December 9, 1909, in State of New York, *Report of the Committee of the Senate and Assembly Appointed to Investigate Telephone and Telegraph Companies* (Albany, 1910), p. 398.

[9]Ayer Collection of AT&T Advertisements, Collection of Business Americana, National Museum of American History, Smithsonian Institution.

[10]See, e.g., *Pacific Telephone Magazine* (PT&T employee magazine, hereafter PAC TEL MAG), 1907–40, passim; 1914 advertisements in SF PION MU folder labeled "Advertising"; MU IND TEL "Scrapbook" of Southern Indiana Telephone Company clippings; advertisements in directories of the day; "Educating the Public to the Proper Use of the Telephone," *Telephony* 64 (June 21, 1913): 32–33; "Swearing over the Telephone," *Telephony* 9 (1905): 418; and "Advertising and Publicity—1906–1910," box 1317, AT&T ARCH.

[11]On AT&T's institutional advertising, see R. Marchand, "Creating the Corporate Soul: The Origins of Corporate Image Advertising in America" (paper presented to the Organization of American Historians, 1980), and N. L. Griese, "AT&T: 1908 Origins of the Nation's Oldest Continuous Institutional Advertising Campaign," *Journal of Advertising* 6 (Summer 1977): 18–24. FCC, *Proposed Report* (n. 5 above), has a chapter on "Public Relations"; see also N. R. Danielian, *AT&T: The Story of Industrial Conquest* (New York, 1939), chap. 13. For a defense of AT&T public relations, see A. W. Page, *The Bell Telephone System* (New York, 1941). Among the publicity efforts along these lines were "free" stories, subsidies of the press, and courting of reporters and politicians (documented in AT&T ARCH). In one comical case, AT&T frantically and apparently unsuccessfully tried in 1920 to pressure Hal Roach to cut out from a Harold Lloyd film he was producing a burlesque scene of central exchange hysteria (see folder "Correspondence—E. S. Wilson, V.P., AT&T," SF PION MU).

stressed those that extended applications of telegraph signaling. For example, an 1878 circular in New Haven—where the first exchange was set up—stated that "your wife may order your dinner, a hack, your family physician, etc., all by Telephone without leaving the house or trusting servants or messengers to do it." (It got almost no response.)[12] In these uses, the telephone directly competed with—and decisively defeated—attempts to create telegraph exchanges that enabled subscribers to signal for services and also efforts to employ printing telegraphs as a sort of "electronic mail" system.[13]

In this era and for some years later, the telephone marketers sought new uses to add to these telegraphic applications. They offered special services over the telephone, such as weather reports, concerts, sports results, and train arrivals. For decades, vendors cast about for novel applications: broadcasting news, sports, and music, night watchman call-in services, and the like. Industry magazines eagerly printed stories about the telephone being used to sell products, alert firefighters about forest blazes, lullaby a baby to sleep, and get out voters on election day. And yet, industry men often attributed weak demand to not having taught the customer "what to do with his telephone."[14]

In the first two decades of the 20th century, telephone advertising became more professionally "modern."[15] AT&T employed a Bos-

[12]Walsh (n. 2 above), p. 47.

[13]S. Schmidt, "The Telephone Comes to Pittsburgh" (master's thesis, University of Pittsburgh, 1948); Pool, *Forecasting* (n. 2 above), p. 30; D. Goodman, "Early Electrical Communications and the City: Applications of the Telegraph in Nineteenth-Century Urban America" (unpub. paper, Department of Social Sciences, Carnegie-Mellon University, n.d., courtesy of Joel Tarr); and "Telephone History of Dundee, Ontario," City File, BELL CAN HIST.

[14]On special services and broadcasting, see Walsh (n. 2 above), p. 206; S. H. Aronson, "Bell's Electrical Toy: What's the Use? The Sociology of Early Telephone Usage," pp. 15–39, and I. de S. Pool et al., "Foresight and Hindsight: The Case of the Telephone," pp. 127–58, both in Pool, ed., *Social Impact* (n. 2 above); "Broadening the Possible Market," *Printers' Ink* 74 (March 9, 1911): 20; G. O. Steel, "Advertising the Telephone," *Printers' Ink* 51 (April 12, 1905): 14–17; and F. P. Valentine, "Some Phases of the Commercial Job," *Bell Telephone Quarterly* 5 (January 1926): 34–43. For illustrations of uses, see, e.g., PAC TEL MAG (October 1907), p. 6, (January 1910), p. 9, (December 1912), p. 23, and (October 1920), p. 44; and the independent magazine, *Telephony*. E.g., the index to vol. 71 (1916) of *Telephony* lists the following under "Telephone, novel uses of": "degree conferred by telephone, dispatching tugs in harbor service, gauging water by telephone, telephoning in an aeroplane." On complaints about not having taught the public, see the quotation from H. B. Young, ca. 1929, pp. 91, 100 in "Publicity Conferences—Bell System—1921–34," box 1310, AT&T ARCH, but similar comments appear in earlier years, as well as positive claims, such as Vail's in 1909.

[15]The following discussion draws largely from examination of advertisement collections at the archives listed in n. 2. Space does not permit more than a few examples

ton agency to dispense "free publicity" and later brought its chief, J. D. Ellsworth, into the company. It began national advertising campaigns and supplied local Bell companies with copy for their regional presses. Some of the advertising was implicitly competitive (e.g., stressing that Bell had long-distance service), and much of it was institutional, directed toward shaping a favorable public opinion about the Bell System. Advertisements for selling service employed drawings, slogans, and texts designed to make the uses of the telephone—not just the technology—attractive. (The amount and kind of advertising fluctuated, especially in the Bell System, in response to competition, available supplies, and political concerns.)[16]

From roughly 1900 to World War I, Bell's publicity agency advertised uses of the telephone by planting newspaper "stories" on telephones in farm life, in the church, in hotels, and the like.[17] The national advertisements, beginning around 1910, addressed mostly businessmen. They stressed that the telephone was impressive to customers and saved time, both at work and at home, and often noted the telephone's convenience for planning and for keeping in touch with the office during vacations.

A second major theme was household management. A 1910 series, for example, presented detailed suggestions: Subscribers could telephone dressmakers, florists, theaters, inns, rental agents, coal dealers, schools, and the like. Other uses were suggested, too, such as conveying messages of moderate urgency (a businessman calling home to say that he will be late, calling a plumber), and conveying invitations (to an impromptu party, for a fourth at bridge).

Sociability themes ("visiting" kin by telephone, calling home from a business trip, and keeping "In Touch with Friends and Relatives")

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of hundreds of advertisements in the sources. See esp. at AT&T ARCH, files labeled "Advertising and Publicity"; at SF PION MU, folders labeled "Advertising" and "Publicity Bureau"; at BELL CAN HIST, "Scrapbooks"; at ILL BELL INFO, "AT&T Advertising" and microfilm 384B, "Adver."; and at the Ayer Collection (n. 9 above), the AT&T series.

[16]For explicit discussions, see Mahon (n. 2 above), e.g., pp. 79, 89; Publicity Vice-President A. W. Page's comments in "Bell System General Commercial Conference, 1930," microfilm 368B, ILL BELL INFO; and comments by Commercial Engineer K. S. McHugh in "Bell System General Commercial Conference on Sales Matters, 1931," microfilm 368B, ILL BELL INFO. On the origins of in-house advertising, see N. L. Griese, "1908 Origins" (n. 11 above).

[17]See correspondence in "Advertising and Publicity—Bell System—1906–1910, Folder 1," box 1317, AT&T ARCH. Some reports claimed that thousands of stories were placed in hundreds of publications. Apparently no national advertising campaigns were conducted prior to these years; Bell marketing strategy seemed largely confined to price and service competition. See N. C. Kingsbury, "Results from the American Telephone's National Campaign," *Printers' Ink* (June 29, 1916): 182–84.

appeared, but they were relatively rare and almost always suggested sending a message such as an invitation or news of safe arrival rather than having a conversation. A few advertisements also pointed out the modernity of the telephone ("It's up to the times!"). But the major uses suggested in early telephone advertising were for business and household management; sociability was rarely advised.[18]

With the decline of competition and the increase in regulation during the 1910s, Bell stressed public relations even more and pressed local companies to follow suit. AT&T increasingly left advertising basic services and uses to its subsidiaries, although much of the copy still originated in New York, and the volume of such advertising declined. Material from Pacific Telephone and Telegraph (PT&T), apparently a major advertiser among the Bell companies, indicates the substance of "use" advertising during that era.[19]

PT&T advertisements for 1914 and 1915 include, aside from informational notices and general paeans to the telephone, a few suggestions for businessmen (e.g., "You fishermen who feel these warm days of Spring luring you to your favorite stream. . . . You can adjust affairs before leaving, ascertain the condition of streams, secure accommodations, and always be in touch with business and home"). Several advertisements mention the home or women, such as those suggesting that extension telephones add to safety and those encouraging shopping by telephone. Just one advertisement in this set explicitly suggests an amiable conversation: A grandmotherly woman is speaking on the telephone, a country vista visible through the window behind her, and says: "My! How sweet and clear my daughter's voice sounds! She seems to be right here with me!" The text reads: "Let us suggest a long distance visit home today." But this sort of advertisement was unusual.

During and immediately after World War I, there was no occasion to promote telephone use, since the industry struggled to meet demand pent up by wartime diversions. Much publicity tried to ease customer irritation at delays.

Only in the mid-1920s did AT&T and the Bell companies refo-

[18]In addition to the advertising collections, see A. P. Reynolds, "Selling a Telephone" (to a businessman), *Telephony* 12 (1906): 280–81; id., "The Telephone in Retail Business," *Printers' Ink* 61 (November 27, 1907): 3–8; and "Bell Encourages Shopping by Telephone," ibid., vol. 70 (January 19, 1910).

[19]Letter from AT&T Vice-President Reagan to PT&T President H. D. Pillsbury, March 4, 1929, in "Advertising," SF PION MU; W. J. Phillips, "The How, What, When and Why of Telephone Advertising," talk given July 7, 1926, in ibid.; and "Advertising Conference—Bell System—1916," box 1310, AT&T ARCH, p. 44.

cus their attention, for the first time in years, to sales efforts.[20] The system was a major advertiser, and Bell leaders actively discussed advertising during the 1920s. Copy focused on high-profit services, such as long distance and extension sets; modern "psychology," so to speak, influenced advertising themes; and Bell leaders became more sensitive to the competition from other consumer goods. Sociability suggestions increased, largely in the context of long-distance marketing.

In the United States, long-distance advertisements still overwhelmingly targeted business uses, but "visiting" with kin now appeared as a frequent suggestion. Bell Canada, for some reason, stressed family ties much more. Typical of the next two decades of Bell Canada's long-distance advertisements are these, both from 1921: "Why night calls are popular. How good it would sound to hear mother's voice tonight, he thought—for there were times when he was lonely—mighty lonely in the big city"; and "it's a weekly affair now, those fond intimate talks. Distance rolls away and for a few minutes every Thursday night the familiar voices tell the little family gossip that both are so eager to hear." Sales pointers to employees during this era often suggested providing customers with lists of their out-of-town contacts' telephone numbers.

In the 1920s, the advertising industry developed "atmosphere" techniques, focusing less on the product and more on its consequences for the consumer.[21] A similar shift may have begun in Bell's advertising, as well: "The Southwestern Bell Telephone Company has decided [in 1923] that it is selling something more vital than distance, speed or accuracy. . . . [T]he telephone . . . almost brings [people] face to face. It is the next best thing to personal contact. So the fundamental purpose of the current advertising is to sell the company's subscribers their voices at their true worth—to help them realize that 'Your Voice is You.'. . . to make subscribers think of the telephone whenever they think of distant friends or relatives. . . . "[22] This attitude was apparently only a harbinger, because during most of the 1920s the sociability theme was largely re-

[20]See n. 16 above.

[21]D. Pope, *The Making of Modern Advertising* (New York, 1983); S. Fox, *The Mirror Makers: A History of American Advertising and Its Creators* (New York, 1984); M. Schudson, *Advertising: The Uneasy Persuasion* (New York, 1985), pp. 60ff; R. Marchand, *Advertising the American Dream: Making Way for Modernity, 1920–1940* (Berkeley, Calif., 1985); and R. Pollay, "The Subsiding Sizzle: A Descriptive History of Print Advertising, 1900–1980," *Journal of Marketing* 49 (Summer 1985): 24–37.

[22]W. B. Edwards, "Tearing Down Old Copy Gods," *Printers' Ink* 123 (April 26, 1923): 65–66.

stricted to long distance and did not appear in many basic service advertisements.

Bell System salesmen spent the 1920s largely selling ancillary services, such as extension telephones, upgrading from party lines, and long distance, to current subscribers, rather than finding new customers. Basic residential rates averaged two to three dollars a month (about 2 percent of average manufacturing wages), not much different from a decade earlier, and Bell leaders did not consider seeking new subscribers to be sufficiently profitable to pursue seriously.[23] The limited new subscriber advertising continued the largely practical themes of earlier years. PT&T contended that residential telephones, especially extensions, were useful for emergencies, for social convenience (don't miss a call about an invitation, call your wife to set an extra place for dinner), and for avoiding the embarrassment of borrowing a telephone, as well as for its familiar business uses. A 1928 Bell Canada sales manual stressed household practicality first and social invitations second as tactics for selling basic service.[24]

Then, in the late 1920s, Bell System leaders—prodded perhaps by the embarrassment that, for the first time, more American families owned automobiles, gas service, and electrical appliances than subscribed to telephones—pressed a more aggressive strategy. They built up a full-fledged sales force. And they sought to market the telephone as a "comfort and convenience"—that is, as more than a practical device—drawing somewhat on the psychological, sensualist themes in automobile advertising. They focused not only on upgrading the service of current subscribers but also on reaching those car owners and electricity users who lacked telephones. And the *social* character of the telephone was to be a key ingredient in the new sales strategies.[25]

Before "comfort and convenience" could go far, however, the Depression drew the industry's attention to basic service once again. Subscribers were disconnecting. Bell companies mounted campaigns to

[23]On rates, see W. F. Gray, "Typical Schedules for Rates of Exchange Service," and related discussion, in "Bell System General Commercial Engineers' Conference, 1924," microfilm 364B, ILL BELL INFO.

[24]Bell Telephone Company of Canada, "Selling Service on the Job," ca. 1928, cat. 12223, BELL CAN HIST.

[25]Comments, esp. by AT&T vice-presidents Page and Gherardi, during "General Commercial Conference, 1928," and "Bell System General Commercial Conference, 1930," both microfilm 368B, ILL BELL INFO, expressed a view that telephones should be part of consumers' "life-styles," not simply their practical instruments. One hears many echoes of "comfort and convenience" at lower Bell levels during this period.

save residential connections by mobilizing *all* employees to sell or save telephone hookups on their own time (a program that had started before the Crash), expanding sales forces, advertising to current subscribers, and mounting door-to-door "save" and "nonuser" campaigns in some communities.[26] The "pitches" PT&T suggested to its employees included convenience (e.g., saving a trip to market), avoiding the humiliation of borrowing a neighbor's telephone, and simply being "modern." Salesmen actually seemed to rely more on pointing out the emergency uses of the telephone—an appeal especially telling to parents of young children—and suggesting that job offers might come via the telephone. Having a telephone so as to be available to friends and relatives was a lesser sales point. By now, a half-century since A. G. Bell's invention, salespeople did not have to sell telephone service itself but had to convince potential customers that they needed a telephone in their own homes.[27]

During the Depression, long-distance advertising continued, employing both business themes and the themes of family and friendship. But basic service advertising, addressed to both nonusers and would-be disconnectors, became much more common than it had been for twenty years.

The first line of argument in print ads for basic service was practicality—emergency uses, in particular—but suggestions for sociable conversations were more prominent than they had been before. A 1932 advertisement shows four people sitting around a woman who is speaking on the telephone. "Do Come Over!" the text reads, "Friends who are linked by telephone have good times." A 1934 Bell Canada advertisement features a couple who have just resubscribed and who testify, "We got out of touch with all of our friends and missed the good times we have now." A 1935 advertisement asks, "Have you ever watched a person telephoning to a friend? Have you noticed how readily the lips part into smiles . . . ?" And 1939 copy states, "Some one thinks of some one, reaches for the telephone, and all is well." A 1937 AT&T advertisement reminds us that "the telephone is vital in emergencies, but that is not the whole of its service. . . . Friendship's path often follows the trail of the telephone wire." These family-and-friend mo-

[26]See A. Fancher, "Every Employee Is a Salesman for American Telephone and Telegraph," *Sales Management* 28 (February 26, 1931): 45–51, 472; "Bell Conferences," 1928 and 1930 (n. 25 above), esp. L. J. Billingsley, "Presention of Disconnections," in 1930 conference; *Pacemaker*, a sales magazine for PT&T, ca. 1928–31, SF PION MU; and *Telephony*, passim, 1931–36.

[27]PT&T *Pacemaker;* interviews by John Chan with retired industry executives in northern California; see also J. E. Harrel, "Residential Exchange Sales in New England Southern Area," in "Bell Conference, 1931" (n. 16 above), pp. 67ff.

tifs, more frequent and frank in the 1930s, forecast the jingles of today, such as " . . . a friendly voice, like chicken soup/is good for your health/Reach out, reach out and touch someone."[28]

This brief chronology draws largely from prepared copy in industry archives, not from actual printed advertisements. A systematic survey, however, of two newspapers in northern California confirms the impression of increasing sociability themes. Aside from one 1911 advertisement referring to farm wives' isolation, the first sociability message in the *Antioch Ledger* appeared in 1929, addressed to parents: "No girl wants to be a wallflower." It was followed in the 1930s with notices for basic service such as "Give your friends straight access to your home," and "Call the folks now!" In 1911, advertisements in the *Marin* (County) *Journal* stressed the convenience of the telephone for automotive tourists. Sociability became prominent in both basic and long-distance advertisements in the late 1920s and the 1930s with suggestions that people "broaden the circle of friendly contact" (1927), "Voice visit with friends in nearby cities" (1930), and call grandmother (1935), and with the line, "I got my telephone for convenience. I never thought it would be such fun!" (1940).[29]

The emergence of sociability also appears in guides to telephone salesmen. A 1904 instruction booklet for sales representatives presents many selling points, but only one paragraph addresses residential service. That paragraph describes ways that the telephone saves time and labor, makes the household run smoothly, and rescues users in emergencies, but the only barely social use it notes is that the telephone "invites one's friends, asks them to stay away, asks them to hurry and enables them to invite in return." Conversation—telephone "visiting"—per se is not mentioned.

A 1931 memorandum to sales representatives, entitled "Your Tele-

[28]There is some variation among the advertising collections I examined. Illinois Bell's basic service advertisements used during the Depression are, for the most part, similar to basic service ads used a generation earlier. The Pacific Bell and Bell Canada advertisements feature sociable conversations much more. On the other hand, the Bell Canada ads are distinctive in that sociability is almost exclusively a family matter. Friendship, featured in U.S. ads all along, emerges clearly in the Canadian ads only in the 1930s. The 1932 ad cited in the text appears in the August 17 issue of the *Antioch* (Calif.) *Ledger*. The "chicken soup" jingle, sung by Roger Miller, was a Bell System ad in 1981. On the "Touch Someone" campaigns, see M. J. Arlen, *Thirty Seconds* (New York, 1980). See also "New Pitch to Spur Phone Use," *New York Times*, October 23, 1985, p. 44.

[29]These particular newspapers were examined as part of a larger study on the social history of the telephone that will include case studies of three northern California communities from 1890 to 1940.

phone," is, on the other hand, full of tips on selling residential service and encouraging its use. Its first and longest subsection begins: "*Fosters friendships*. Your telephone will keep your personal friendships alive and active. Real friendships are too rare and valuable to be broken when you or your friends move out of town. Correspondence will help for a time, but friendships do not flourish for long on letters alone. When you can't visit in person, telephone periodically. Telephone calls will keep up the whole intimacy remarkably well. There is no need for newly-made friends to drop out of your life when they return to distant homes." A 1935 manual puts practicality and emergency uses first as sales arguments but explicitly discusses the telephone's "social importance," such as saving users from being "left high and dry by friends who can't reach [them] conveniently."[30]

This account, so far, covers the advertising of the Bell System. There is less known and perhaps less to know about the independent companies' advertising. Independents' appeals seem much like those of the Bell System, stressing business, emergencies, and practicality, except perhaps for showing an earlier sensitivity to sociability among their rural clientele.[31]

In sum, the variety of sales materials portray a similar shift. From the beginning to roughly the mid-1920s, the industry sold service as a practical business and household tool, with only occasional mention of social uses and those largely consisting of brief messages. Later sales arguments, for both long-distance and basic service, featured social uses prominently, including the suggestion that the telephone be used for converations ("voice visiting") among

[30]Central Union Telephone Company Contracts Department, *Instructions and Information for Solicitors*, 1904, ILL BELL INFO. Note that Central Union had been, at least through 1903, one of Bell's most aggressive solicitors of business. Illinois Bell Commercial Department, *Sales Manual* 1931, microfilm, ILL BELL INFO. Ohio Bell Telephone Company, "How You Can Sell Telephones," 1935, file "Salesmanship," BELL CAN HIST.

[31]Until 1894, independent companies did not exist. For years afterward, they largely tried to meet unfilled demand in the small cities and towns Bell had underserved. In other places, they advertised competitively against Bell. Nevertheless, advertising men often exhorted the independents to use "salesmanship in print" to encourage basic service and extensive use. See, e.g., J. A. Schoell, "Advertising and Other Thoughts of the Small Town Man," *Telephony* 70 (June 10, 1916): 40–41; R. D. Mock, "Fundamental Principles of the Telephone Business: Part V, Telephone Advertising," series in ibid., vol. 71 (July 22–November 21, 1916); D. Hughes, "Right Now Is the Time to Sell Service," ibid., 104 (June 10, 1933): 14–15; and L. M. Berry, "Helpful Hints for Selling Service," ibid., 108 (February 2, 1935): 7–10. See also Kellogg Company, "A New Business Campaign for ———" (Chicago: Kellogg, 1929), MU IND TEL.

friends and family. While it would be helpful to confirm this impressionistic account with firm statistics, for various reasons it is difficult to draw an accurate sample of advertising copy and salesmen's pitches for over sixty years. (For one, we have no easily defined "universe" of advertisements. Are the appropriate units specific printed ads, or ad campaigns? How are duplicates to be handled? Or ads in neighboring towns? Do they include planted stories, inserts in telephone bills, billboards, and the like? Should locally generated ads be included? And what of nationally prepared ads not used by the locals? For another, we have no clear "population" of ads. The available collections are fragmentary, often preselected for various reasons.) An effort in that direction appears, however, in table 2, in which the numbers of "social" advertisements show a clear increase, both absolutely and relatively.

TABLE 2
COUNTS OF DOMINANT ADVERTISING THEMES BY PERIOD

Sources and Types of Advertisements	Prewar	1919–29	1930–40
Antioch (Calif.) *Ledger*:			
Social, sociability	1 (1)	1 (1)	6 (4)
Business, businessmen	6 (5)	1 (1)	2 (1)
Household, convenience, etc.	5 (5)	3 (3)	4 (3)
Public relations, other	0 (0)	4 (3)	1 (1)
Total	12 (11)	9 (8)	13 (9)
Approximate ratio of social to others	1:11 (1:10)	1:8 (1:7)	1:1 (1:1)
Marin (Calif.) *Journal*:			
Social, sociability	1 (1)	5 (2)	43 (20)
Business, businessmen	2 (2)	8 (2)	10 (3)
Household, convenience, etc.	12 (12)	3 (3)	20 (20)
Public relations, other	0 (0)	19 (13)	25 (16)
Total	15 (15)	35 (20)	98 (59)
Approximate ratio of social to others	1:14 (1:14)	1:6 (1:9)	1:1 (1:2)
Bell Canada:			
Social, sociability	5 (2)	25 (1)	59* (9)
Business, businessmen	20* (20)	15 (2)	24* (4)
Household, convenience, etc.	28 (28)	3 (3)	23* (6)
Public relations, other	30* (30)	25 (40)	2 (2)
Total	83* (80)	68 (46)	108* (21)
Approximate ratio of social to others	1:16 (1:39)	1:2 (1:45)	1:1 (1:1)

TABLE 2 (*continued*)

Sources and Types of Advertisements	Prewar	1919–29	1930–40
Pacific Telephone, 1914–15:			
Social, sociability	2 (1)	...	...
Business, businessmen	7 (6)	...	...
Household, convenience, etc.	18 (16)	...	...
Public relations, other	16 (9)	...	...
Total	43 (32)	...	...
Approximate ratio of social to others	1:21 (1:31)	...	...
Assorted Bell ads, 1906–10:			
Social, sociability	4 (4)	...	...
Business, businessmen	13 (12)	...	...
Household, convenience, etc.	11 (11)	...	...
Public relations, other	9 (9)	...	...
Total	37 (36)	...	...
Approximate ratio of social to others	1:8 (1:8)	...	...

SOURCES.—Advertisements in the *Antioch Ledger* were sampled from 1906 to 1940 by Barbara Loomis; those in the *Marin Journal* were sampled from 1900 to 1940 by John Chan. The Bell Canada collection appears in scrapbooks at Bell Canada Historical; the Pacific collection is in the San Francisco Pioneer Telephone Museum. The AT&T advertisements are from AT&T ARCH, box 1317. Other, spotty collections were used for the study but not counted here because they were not as systematic. All coding was done by the author.

NOTE.—Counts in parentheses exclude explicitly long-distance advertisements. Usually each ad had one dominant theme. When more than one seemed equal in weight, the ad was counted in both categories. "Social, sociability" refers to the use of the telephone for personal contact, including season's greetings, invitations, and conversation between friends and family. (Note that the inclusion of brief messages in this category makes the analysis a conservative test of the argument that there was a shift toward sociability themes.) "Business, businessmen" refers to the explicit use of the telephone for business purposes or general appeals to businessmen—e.g., that the telephone will make one a more forceful entrepreneur. "Household, convenience, etc." includes the use of the telephone for household management, personal convenience (e.g., don't get wet, order play tickets), and for emergencies, such as illness or burglary. "Public relations, other" includes general institutional advertising, informational notices (such as how to use the telephone), and other miscellaneous. Perhaps the most conservative index is the ratio of non-long-distance social ads to non-long-distance household ads. (Business ads move to speciality magazines over the years; public information ads fluctuate with political events; and long-distance ads may be "inherently" social.) In the *Antioch Ledger*, this ratio changes from 1:5 to 4:3; in the *Marin Journal*, from 1:12 to 1:1; and in Bell Canada's ads, from 1:14 to 1.5:1. Even these ratios understate the shift, for several reasons. One, I was much more alert to social than to other ads and was more thorough with early social ads than any other category. Two, the household category is increased in the later years by numerous ads for extension telephones. Three, the nature of the social ads counted here changes. The earlier ones overwhelmingly suggest using the telephone for greetings and invitations, not conversation. With rare exception, only the later ones discuss friendliness and "warm human relationships" and suggest chats.

*Estimated.

Industry Attitudes toward Sociability

This change in advertising themes apparently reflected a change in the actual beliefs industry men held about the telephone. Alexander Graham Bell himself forecast social chitchats using his invention. He predicted that eventually Mrs. Smith would spend an hour on the telephone with Mrs. Brown "very enjoyably . . . cutting up Mrs. Robinson."[32] But for decades few of his successors saw it that way.

Instead, the early telephone vendors often battled their residential customers over social conversations, labeling such calls "frivolous" and "unnecessary." For example, an 1881 announcement complained, "The fact that subscribers have been free to use the wires as they pleased without incurring additional expense [i.e., flat rates] has led to the transmission of large numbers of communications of the most trivial character."[33] In 1909, a local telephone manager in Seattle listened in on a sample of conversations coming through a residential exchange and determined that 20 percent of the calls were orders to stores and other businesses, 20 percent were from subscribers' homes to their own businesses, 15 percent were social invitations, and 30 percent were "purely idle gossip"—a rate that he claimed was matched in other cities. The manager's concern was to reduce this last, "unnecessary use." One tactic for doing so, in addition to "education" campaigns on proper use of the telephone, was to place time limits on calls (in his survey the average call had lasted over seven minutes). Time limits were often an explicit effort to stop people who insisted on chatting when there was "business" to be conducted.[34]

[32]Quoted in Aronson, "Electrical Toy" (n. 14 above).

[33]Proposed announcement by National Capitol Telephone Company, in letter to Bell headquarters, January 20, 1881, box 1213, AT&T ARCH. In a similar vein, the president of Bell Canada confessed, ca. 1890, to being unable to stop "trivial conversations"; see Collins, *A Voice* (n. 2 above), p. 124. The French authorities were also exasperated by nonserious uses; see C. Bertho, *Télégraphes et téléphones* (Paris, 1980), pp. 244–45.

[34]C. H. Judson, "Unprofitable Traffic—What Shall Be Done with It?" *Telephony* 18 (December 11, 1909): 644–47, and PAC TEL MAG 3 (January, 1910): 7. He also writes, "the telephone is going beyond its original design, and it is a positive fact that a large percentage of telephones in use today on a flat rental basis are used more in entertainment, diversion, social intercourse and accommodation to others, than in actual cases of business or household necessity" (p. 645). MacMeal, *Independent* (n. 2 above), p. 240, reports on a successful campaign in 1922 to discourage gossipers through letters and advertisements. Typically, calls were—at least officially—limited to five minutes in many places, although it is unclear how well limits were enforced.

An exceptional few in the industry, believing in a more "populist" telephony, did, however, try to encourage such uses. E. J. Hall, Yale-educated and originally manager of his family's firebrick business, initiated the first "measured service" in Buffalo in 1880 and later became an AT&T vice-president. A pleader for lower rates, Hall also defended "trivial" calls, arguing that they added to the total use-value of the system. But the evident isolation of men like Hall underlines the dominant antisociability view of the pre–World War I era.[35]

Official AT&T opinions came closer to Hall's in the later 1920s when executives announced that, whereas the industry had previously thought of telephone service as a practical necessity, they now realized that it was more: it was a "convenience, comfort, luxury"; its value included its "trivial" social uses. In 1928, Publicity Vice-President A. W. Page, who had entered AT&T from the publishing industry the year before, was most explicit when he criticized earlier views: "There had also been the point of view [in the Bell System and among the public] about not using the telephone for frivolous conversation. This is about as commercial as if the automobile people should advertise. 'Please do not take out this car unless you are going on a serious errand. . . .' We are faced, I think, with a state of public consciousness that the telephone is a necessity and not to be trifled with, certainly in the home." Bell sales officials were told to sell telephone service as a "comfort and convenience," including as a conversational tool.[36]

Although this change in opinion is most visible for the Bell System, similar trends can be seen in the pages of the journal of the independent companies, *Telephony*, especially in regard to rural customers. Indeed, early conflict about telephone sociability was most acute in rural areas. During the monopoly era, Bell companies largely neglected rural demand. The depth and breadth of

[35]Hall's philosophy is evident in the correspondence over measured service before 1900, box 1127, AT&T ARCH. Decades later, he pushed it in a letter to E. M. Burgess, Colorado Telephone Company, March 30, 1905, box 1309, AT&T ARCH, even arguing that operators should stop turning away calls made by children and should instead encourage such "trivial uses." The biographical information comes from an obituary in AT&T ARCH. Another, more extreme populist was John L. Sabin, of PT&T and the Chicago Telephone Co.; see Mahon (n. 2 above), pp. 29ff.

[36]A. W. Page, "Public Relations and Sales," "General Commercial Conference, 1928," p. 5, microfilm 368B, ILL BELL INFO. See also comments by Vice-President Gherardi and others in same conference and related ones of the period. On Page and the changes he instituted, see G. J. Griswold, "How AT&T Public Relations Policies Developed," *Public Relations Quarterly* 12 (Fall 1967): 7–16; and Marchand, *Advertising* (n. 21 above), pp. 117–20.

that demand became evident in the first two decades of this century, when proportionally more farm than urban households obtained telephones, the former largely from small commercial or cooperative local companies. Sociability both spurred telephone subscription and irritated the largely non-Bell vendors.

The 1907 Census of Telephones argued that in areas of isolated farmhouses "a sense of community life is impossible without this ready means of communication. . . . The sense of loneliness and insecurity felt by farmers' wives under former conditions disappears, and an approach is made toward the solidarity of a small country town." Other official investigations bore similar witness.[37] Rural telephone men also dwelt on sociability. One independent company official stated: "When we started the farmers thought they could get along without telephones. . . . Now you couldn't take them out. The women wouldn't let you even if the men would. Socially, they have been a godsend. The women of the county keep in touch with each other, and with their social duties, which are largely in the nature of church work."[38]

Although the episodic sales campaigns to farmers stressed the practical advantages of the telephone, such as receiving market prices, weather reports, and emergency aid, the industry addressed the social theme more often to them than to the general public. A PT&T series in 1911, for example, focused on the telephone in emergencies, staying informed, and saving money. But one additional advertisement said it was: "A Blessing to the Farmer's Wife. . . . It relieves the monotony of life. She CANNOT be lonesome with the Bell Service. . . ."[39] For all that, telephone professionals who dealt with farm-

[37]BOC, *Special Reports: Telephones: 1907* (Washington, D.C., 1910), pp. 77–78; see also U.S. Congress, Senate, Country Life Commission, 60th Cong., 2d sess., 1909, S. Doc. 705; and F. E. Ward, *The Farm Woman's Problems*, USDA Circular 148 (Washington, D.C., 1920). See also C. S. Fischer, "The Revolution in Rural Telephony," *Journal of Social History* (in press).

[38]Quoted in R. F. Kemp, "Telephones in Country Homes," *Telephony* 9 (June 1905): 433. A 1909 article claims that "[t]he principle use of farm line telephones has been their social use. . . . The telephones are more often and for longer times held for neighborly conversations than for any other purpose." It goes on to stress that subscribers valued conversation with anyone on the line; see G. R. Johnston, "Some Aspects of Rural Telephony," *Telephony* 17 (May 8, 1909): 542. See also R. L. Tomblen, "Recent Changes in Agriculture as Revealed by the Census," *Bell Telephone Quarterly* 9 (October 1932): 334–50; and J. West (C. Withers), *Plainville, U.S.A.* (New York, 1945), p. 10.

[39]The PT&T series appeared in the *Antioch* (Calif.) *Ledger* in 1911. For some examples and discussions of sales strategies to farmers, see Western Electric, "How to Build Rural Lines," n.d., "Rural Telephone Service, 1944–46," box 1310, AT&T ARCH; Stromberg-Carlson Telephone Manufacturing Company, *Telephone Facts for*

ers often fought the use of the line for nonbusiness conversations, at least in the early years. The pages of *Telephony* overflow with complaints about farmers on many grounds, not the least that they tied up the lines for chats.

More explicit appreciation of the value of telephone sociability to farmers emerged later. A 1931 account of Bell's rural advertising activities stressed business uses, but noted that "only within recent years [has] emphasis been given to [the telephone's] usefulness in everyday activities . . . the commonplaces of rural life." A 1932 article in the *Bell Telephone Quarterly* notes that "telephone usage for social purposes in rural areas is fundamentally important." Ironically, in 1938, an independent telephone man claimed that the social theme *had been* but was *no longer* an effective sales point because the automobile and other technologies had already reduced farmers' isolation![40]

As some passages suggest, the issue of sociability was also tied up with gender. When telephone vendors before World War I addressed women's needs for the telephone, they usually meant household management, security, and emergencies. There is evidence, however, that urban, as well as rural, women found the telephone to be useful for sociability.[41] When industry men criticized chatting

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Farmers (Rochester, N.Y., 1903), Warshaw Collection, Smithsonian Institution; "Facts regarding the Rural Telephone," *Telephony* 9 (April 1905): 303. In *Printers' Ink*, "The Western Electric," 65 (December 23, 1908): 3–7; F. X. Cleary, "Selling to the Rural District," 70 (February 23, 1910): 11–12; "Western Electric Getting Farmers to Install Phones," 76 (July 27, 1911): 20–25; and H. C. Slemin, "Papers to Meet 'Trust' Competition," 78 (January 18, 1912): 28.

[40]R. T. Barrett, "Selling Telephones to Farmers by Talking about Tomatoes," *Printers' Ink* (November 5, 1931): 49–50; Tomblen (n. 38 above); and J. D. Holland, "Telephone Service Essential to Progressive Farm Home," *Telephony* 114 (February 19, 1938): 17–20. See also C. S. Fischer, "Technology's Retreat: The Decline of Rural Telephones, 1920–1940," *Social Science History* (in press).

[41]A 1925 survey of women's attitudes toward home appliances by the General Federation of Women's Clubs showed that respondents preferred automobiles and telephones above indoor plumbing; see M. Sherman, "What Women Want in Their Homes," *Woman's Home Companion* 52 (November 1925): 28, 97–98. A census survey of 500,000 homes in the mid-1920s reportedly found that the telephone was considered a primary household appliance because it, with the automobile and radio, "offer[s] the homemaker the escape from monotony which drove many of her predecessors insane"; reported in *Voice Telephone Magazine*, in-house organ of United Communications, December 1925, p. 3, MU IND TEL. One of our interviewees who conducted door-to-door telephone sales in the 1930s said that women were attracted to the service first in order to talk to kin and friends, second for appointments and shopping, and third for emergencies, while, for men, employment and business reasons ranked first. See also Rakow, "Gender" (n. 2 above), and C. S. Fischer, "Women and the Telephone, 1890–1940," paper presented to the American Sociological Association, 1987.

on the telephone, they almost always referred to the speaker as "she." Later, in the 1930s, the explicit appeals to sociability also emphasized women; the figures in such advertisements, for example, were overwhelmingly women.

In rough parallel with the shift in manifest advertising appeals toward sociability, there was a shift in industry attitudes from irritation with to approval of sociable conversations as part of the telephone's "comfort, convenience, and luxury."

Economic Explanations

Why were the telephone companies late and reluctant to suggest sociable conversations as a use? There are several, not mutually exclusive, possible answers. The clearest is that there was no profit in sociability at first but profit in it later.

Telephone companies, especially Bell, argued that residential service had been a marginal or losing proposition, as measured by the revenues and expenses accounted to each instrument, and that business service had subsidized local residential service. Whether this argument is valid remains a matter of debate. Nevertheless, the belief that residential customers were unprofitable was common, especially among line workers, and no doubt discouraged intensive sales efforts to householders.[42] At times, Bell lacked the capital to construct lines needed to meet residential demand. These constraints seemed to motivate occasional orders from New York not to advertise basic service or to do so only to people near existing and unsaturated lines.[43] And, at times, there was a technical incompatibility

[42]See, e.g., J. W. Sichter, "Separations Procedures in the Telephone Industry," paper P-77-2, Harvard University Program on Information Resources (Cambridge, Mass., 1977); *Public Utilities Digest*, 1930s–1940s, passim; "Will Your Phone Rates Double?" *Consumer Reports* (March 1984): 154–56. Chan's industry interviewees believed this cross subsidy to be true, as, apparently, did AT&T's commercial engineers; see various "Conferences" cited above, AT&T ARCH and ILL BELL INFO.

[43]E.g., commercial engineer C. P. Morrill wrote in 1914 that "we are not actively seeking new subscribers except in a few places where active competition makes this necessary. Active selling is impossible due to rapid growth on the Pacific Coast." He encouraged sales of party lines in congested areas, individual lines in place of party lines elsewhere, extensions, more calling, directory advertisements, etc., rather than expanding basic service into new territories; see PAC TEL MAG 7 (1914): 13–16. And, in 1924, the Bell System's commercial managers decided to avoid canvassing in areas that would require plant expansion and to stress instead long-distance calls and services, especially for large business users; see correspondence from B. Gherardi, vice-president, AT&T, to G. E. McFarland president, PT&T, July 14, 1924, and November 26, 1924, folder "282—Conferences," SF PION MU, and exchage with McFarland, May 10 and May 20, 1924, folder "Correspondence—B. Gherardi," SF PION MU.

between the quality of service Bell had accustomed its business subscribers to expect and the quality residential customers were willing to pay for. Given these considerations, Bell preferred to focus on the business class, who paid higher rates, bought additional equipment, and made long-distance calls.[44]

Still, when they did address residential customers, why did telephone vendors not employ the sociability theme until the 1920s, relying for so long only on practical uses? Perhaps social calls were an untouched and elastic market of consumer demand. Having sold the service to those who might respond to practical appeals—and perhaps by World War I everyone knew those practical uses—vendors might have thought that further expansion depended on selling "new" social uses of the telephone.[45] Similarly, vendors may have thought they had already enrolled all the subscribers they could—42 percent of American households in 1930—and shifted attention to encouraging use, especially of toll lines. We have seen how sales efforts for intercity calls invoked friends and family. But this explanation does not suffice. It leaves as a puzzle why the sociability themes continued in the Depression when the industry focused again on simply ensuring subscribers and also why the industry's internal attitudes shifted as well.

Perhaps the answer is in the rate structures. Initially, telephone companies charged a flat rate for unlimited local use of the service. In such a system, extra calls and lengthy calls cost users nothing but are unprofitable to providers because they take operator time and, by occupying lines, antagonize other would-be callers. Some industry men explicitly blamed "trivial" calls on flat rates.[46] Discouraging "visiting" on the telephone then made sense.

Although flat-rate charges continued in many telephone exchanges, especially smaller ones, throughout the period, Bell and others instituted "measured service" in full or in part—charging additionally per call—in most large places during the era of competition. In St. Louis in 1898, for example, a four-party telephone cost forty-five dollars a year for 600 calls a year, plus eight cents a call in excess.[47] This system allowed companies to reduce basic subscrip-

[44]The story of the Chicago exchange under John L. Sabin illustrates the point. See R. Garnet, "The Central Union Telephone Company," box 1080, AT&T ARCH.

[45]This point was suggested by John Chan from the interviews.

[46]See n. 33, 34. This is also the logic of a recent New York Telephone Co. campaign to encourage social calls: The advertising will not run in upstate New York "since the upstaters tend to have flat rates and there would be no profit in having them make unnecessary calls" (see "New Pitch," n. 28 above).

[47]Letter to AT&T President Hudson, December 27, 1898, box 1284, AT&T ARCH. On measured service in general, see "Measured Service Rates," boxes 1127,

tion fees and thus attract customers who wanted the service only for occasional use.

Company officials had conflicting motives for pressing measured service. Some saw it simply as economically rational, charging according to use. Others saw it as a means of reducing "trivial" calls and the borrowing of telephones by nonsubscribers. A few others, such as E. J. Hall, saw it as a vehicle for bringing in masses of small users.

The industry might have welcomed social conversations, if it could charge enough to make up for uncompleted calls and for the frustrated subscribers busy lines produced. In principle, under measured service, it could. (As it could with long distance, where each minute was charged.) Although mechanical time metering was apparently not available for most or all of this period, rough time charges for local calls existed in principle, since "messages" were typically defined as five minutes long or any fraction thereof. Thus, "visiting" for twenty minutes should have cost callers four "messages." In such systems, the companies would have earned income from sociability and might have encouraged it.[48]

However, changes from flat rates to measured rates do *not* seem to explain the shift toward sociability around the 1920s. Determining the extent that measured service was actually used for urban residential customers is difficult because rate schedules varied widely from town to town even within the same states. But the timing does not fit. The big exchanges with measured residential rates had them early on. For example, in 1904, 96 percent of Denver's residential subscribers were on at least a partial measured system, and, in 1905, 90 percent of those in Brooklyn, New York, were as well. (Yet, Los Angeles residential customers continued to have flat

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1213, 1287, 1309, AT&T ARCH; F. H. Bethell, "The Message Rate," repr. 1913, AT&T ARCH; H. B. Stroud, "Measured Telephone Service," *Telephony* 6 (September 1903): 153–56, and (October 1903): 236–38; and J. E. Kingsbury, *The Telephone and Telephone Exchanges* (London, 1915), pp. 469–80.

[48]Theodore Vail claimed in 1909 that mechanical time metering was impossible (in testimony to a New York State commission, see n. 8 above, p. 470). See also Judson (n. 34 above), p. 647. In 1928, an operating engineer suggested overtime charges on five-minute calls and stated that equipment for monitoring overtime was now available; see L. B. Wilson, "Report on Commercial Operations, 1927," in "General Commercial Conference, 1928," p. 28, microfilm 368B, ILL BELL INFO. On the five-minute limit, see "Measured Service," box 1127, AT&T ARCH, passim; and Bell Canada, *The First Century of Service* (Montreal, 1980), p. 4. There is no confirmation on how strict operators in fact were in charging overtime. The Bell System, at least, was never known for its laxness in such matters.

rates.)[49] There is little sign that these rate systems altered significantly in the next twenty-five years while sociability themes emerged.

Conversely, flat rates persisted in small exchanges beyond the 1930s. Moreover, sociability themes appeared more often in rural sales campaigns than in urban ones, despite the fact the rural areas remained on flat-rate schedules.

Although concern that long social calls occupied lines and operators—with financial losses to the companies—no doubt contributed to the industry's resistance to sociability, it is not a sufficient explanation of those attitudes or, especially, of the timing of their change.

Technical Explanations

Industry spokesmen early in the era would probably have claimed that technical considerations limited "visiting" by telephone. Extended conversations monopolized party lines. That is why companies, often claiming customer pressure, encouraged, set—or sought legal permission to set—time limits on calls. Yet, this would not explain the shift toward explicit sociability, because as late as 1930, 40–50 percent of Bell's main telephones in almost all major cities were still on party lines, a proportion not much changed from 1915.[50]

A related problem was the tying up of toll lines among exchanges, especially those among villages and small towns. Rural cooperatives complained that the commercial companies provided them with only single lines between towns. The companies resisted setting up more, claiming they were underpaid for that service. This

[49]Denver: letter from E. J. Hall to E. W. Burgess, 1905, box 1309, AT&T ARCH; Brooklyn: BOC, *Telephones, 1902* (n. 4 above); Los Angeles: "Telephone on the Pacific Coast, 1878–1923," box 1045, AT&T ARCH.

[50]On company claims, see, e.g., "Limiting Party Line Conversations," *Telephony* 66 (May 2, 1914): 21; and MacMeal (n. 2 above), p. 224. On party-line data, compare the statistics in the letter from J. P. Davis to A. Cochrane, April 2, 1901, box 1312, AT&T ARCH, to those in B. Gherardi and F. B. Jewett, "Telephone Communications System of the United States," *Bell System Technical Journal* 1 (January 1930): 1–100. The former show, e.g., that, in 1901, in the five cities with the most subscribers, an average of 31 percent of telephones were on party lines. For those five cities in 1929, the percentage was 36. Smaller exchanges tended to have even higher proportions. See also "Supplemental Telephone Statistics, PT&T," "Correspondence—Du Bois," SF PION MU. The case of Bell Canada also fails to support a party-line explanation. Virtually all telephones in Montreal and Toronto were on individual lines until 1920.

single-line connection would create an incentive to suppress social conversations, at least in rural areas. But this does not explain the shift toward sociability either. The bottleneck was resolved much later than the sales shift when it became possible to have several calls on a single line.[51]

The development of long distance might also explain increased sociability selling. Over the period covered here, the technology improved rapidly, AT&T's long-distance charges dropped, and its costs dropped even more. The major motive for residential subscribers to use long distance was to greet kin or friends. Additionally, overtime was well monitored and charged. Again, while probably contributing to the overall frequency of the sociability theme, long-distance development seems insufficient to explain the change. Toll calls as a proportion of all calls increased from 2.5 percent in 1900 to 3.2 percent in 1920 and 4.1 percent in 1930, then dropped to 3.3 percent in 1940. They did not reach even 5 percent of all calls until the 1960s.[52] More important, the shift toward sociability appears in campaigns to sell basic service and to encourage local use, as well as in long-distance ads. (See table 2.)

Cultural Explanations

While both economic and technical considerations no doubt framed the industry's attitude toward sociability, neither seems sufficient to explain the historical change. Part of the explanation probably lies in the cultural "mind-set" of the telephone men.

In many ways, the telephone industry descended directly from the telegraph industry. The instruments are functionally very similar; technical developments sometimes applied to both. The people who developed, built, and marketed telephone systems were predominantly telegraph men. Theodore Vail himself came from a family involved in telegraphy and started his career as a telegrapher. (In contrast, E. J. Hall and A. W. Page, among the supporters of "triviality," had no connections to telegraphy. J. L. Sabin, a man of the

[51]"Carrier currents" allowed multiple conversations on the same line. The first one was developed in 1918, but for many years they were limited to use on long-distance trunk lines, not local toll lines. See, e.g., R. Coe, "Some Distinguishing Characteristics of the Telephone Business," *Bell Telephone Quarterly* 6 (January 1927): 47–51, esp. pp. 49–50; and R. C. Boyd, J. D. Howard, Jr., and L. Pederson, "A New Carrier System for Rural Service," *Bell System Technical Journal* 26 (March 1957): 349–90. The first long-distance carrier line was established in Canada in 1928, after the long-distance sociability theme had emerged; see Bell Canada, *First Century*, no. 46, p. 28.

[52]BOC, *Historical Statistics* (n. 3 above), p. 783.

same bent, did have roots in telegraphy.) Many telephone companies had started as telegraph operations. Indeed, in 1880, Western Union almost displaced Bell as the telephone company. And the organization of Western Union served in some ways as a model for Bell. Telephone use often directly substituted for telegraph use. Even the language used to talk about the telephone revealed its ancestry. For example, an early advertisement claimed that the telephone system was the "cheapest telegraph service ever." Telephone calls were long referred to as "messages." American telegraphy, finally, was rarely used even for brief social messages.[53]

No wonder, then, that the uses proposed first and for decades to follow largely replicated those of a printing telegraph: business communiqués, orders, alarms, and calls for services. In this context, industry men reasonably considered telephone "visiting" to be an abuse or trivialization of the service. Internal documents suggest that most telephone leaders typically saw the technology as a business instrument and a convenience for the middle class, claimed that people had to be sold vigorously on these marginal advantages, and believed that people had no "natural" need for the telephone—indeed, that most (the rural and working class) would never need it. Customers would have to be "educated" to it.[54] AT&T Vice-

[53]On the telegraph background of early telephone leaders, see, e.g., A. B. Paine, *Theodore N. Vail* (New York, 1929); Rippey (n. 2 above); and W. Patten, *Pioneering the Telephone in Canada* (Montreal: Telephone Pioneers, 1926). Interestingly, this was true of Bell and the major operations. But the leaders of small-town companies were typically businessmen and farmers; see, e.g., *On the Line* (Madison: Wisconsin State Telephone Association, 1985). On Western Union and Bell, see G. D. Smith, *The Anatomy of a Business Strategy: Bell, Western Electric, and the Origins of the American Telephone Industry* (Baltimore, 1985). The "cheapest telegraph" appears in a Buffalo flier of November 13, 1880, box 1127, AT&T ARCH. On the infrequent use of the telegraph for social messages, see R. B. DuBoff, "Business Demand and Development of the Telegraph in the United States, 1844–1860," *Business History Review* 54 (Winter 1980): 459–79.

[54]In the very earliest days, Vail had expected that the highest level of development would be one telephone per 100 people; by 1880, development had reached four per 100 in some places; see Garnet (n. 2 above), p. 133, n. 3. It reached one per 100 Americans before 1900 (see table 1). In 1905, a Bell estimate assumed that twenty telephones per 100 Americans was the saturation point and even that "may appear beyond reason"; see "Estimated Telephone Development, 1905–1920," letter from S. H. Mildram, AT&T, to W. S. Allen, AT&T, May 22, 1905, box 1364, AT&T ARCH. The saturation date was forecast for 1920. This estimate was optimistic in its projected *rate* of diffusion—twenty per 100 was reached only in 1945—but very pessimistic in its projected *level* of diffusion. That level was doubled by 1960 and tripled by 1980. One reads in Bell documents of the late 1920s of concern that the automobile and other new technologies were far outstripping telephone diffusion. Yet, even then, there seemed to be no assumption that the telephone would reach the near universality in American homes of, say, electricity or the radio.

President Page was reacting precisely against this telegraphy perspective in his 1928 defense of "frivolous" conversation. At the same conference, he also decried the psychological effect of telephone advertisements that explicitly compared the instrument to the telegraph.[55]

Industry leaders long ignored or repressed telephone sociability—for the most part, I suggest, because such conversations did not fit their understandings of what the technology was supposed to be for. Only after decades of customer insistence on making such calls—and perhaps prodded by the popularity of competing technologies, such as the automobile and radio—did the industry come to adopt sociability as a means of exploiting the technology.

This argument posits a generation-long lag, a mismatch, between how subscribers used the telephone and how industry men thought it would be used. A variant of the argument (posed by several auditors of this article) suggests that there was no mismatch, that the industry's attitudes and advertising accurately reflected public practice. Sales strategies changed toward sociability around the mid-1920s because, in fact, people began using the telephone that way more. This increase in telephone visiting occurred for perhaps one or more reasons—a drop in real costs, an increase in the number of subscribers available to call, clearer voice transmission, more comfortable instruments (from wall sets to the "French" handsets), measured rates, increased privacy with the coming of automatic dial switching, and so on—and the industry's marketing followed usage.

To address this argument fully would require detailed evidence on the use of the telephone over time, which we do not have. Recollections by some elderly people suggest that they visited by telephone less often and more quickly in the "old days," but they cannot specify exact rates or in what era practices changed.[56] On the other hand, anecdotes, comments by contemporaries, and fragments of numerical data (e.g., the 1909 Seattle "study") suggest that residential users regularly visited by telephone before the mid-1920s, whatever the etiquette was supposed to be, and that such calls at least equaled calls regarding household management. Yet, telephone advertising in the period overwhelmingly stressed practical use and ignored or suppressed sociability use.

Changes in customers' practices may have helped spur a change

[55]Page 53 in L. B. Wilson (chair), "Promoting Greater Toll Service," "General Commercial Conference, 1928," microfilm 368B, ILL BELL INFO.

[56]This comment is based on the oral histories reported by Rakow (n. 2 above) and by several interviews conducted in San Rafael, Calif., by John Chan for this project. See also Fischer, "Women" (n. 41).

in advertising—although there is no direct evidence of this in the industry archives—but some sort of mismatch existed for a long time between actual use and marketing. Its source appears to be, in large measure, cultural.

This explanation gains additional plausibility from the parallel case of the automobile, about which space permits only brief mention. The early producers of automobiles were commonly former bicycle manufacturers who learned their production techniques and marketing strategies (e.g., the dealership system, annual models) during the bicycle craze of the 1890s. As the bicycle was then, so was the automobile initially a plaything of the wealthy. The early sales campaigns touted the automobile as a leisure device for touring, joyriding, and racing. One advertising man wondered as late as 1906 whether "the automobile is to prove a fad like the bicycle or a lasting factor in the industry of the country."[57]

That the automobile had practical uses dawned on the industry quickly. Especially after the success of the Ford Model T, advertisements began stressing themes such as utility and sociability—in particular, that families could be strengthened by touring together. Publicists and independent observers alike praised the automobile's role in breaking isolation and increasing community life.[58] As with the telephone, automobile vendors largely followed a market-

[57]Among the basic sources on the history of the automobile drawn from are: J. B. Rae, *The American Automobile: A Brief History* (Chicago, 1965); id., *The Road and Car in American Life* (Cambridge, Mass., 1971); J. J. Flink, *America Adopts the Automobile, 1895–1910* (Cambridge, Mass., 1970); id., *The Car Culture* (Cambridge, Mass., 1976); and J.-P. Bardou, J.-J. Chanaron, P. Fridenson, and J. M. Laux, *The Automobile Revolution,* trans. J. M. Laux (Chapel Hill, N.C., 1982). The advertising man was J. H. Newmark, "Have Automobiles Been Wrongly Advertised?" *Printers' Ink* 86 (February 5, 1914): 70–72. See also id., "The Line of Progress in Automobile Advertising," ibid., 105 (December 26, 1918): 97–102.

[58]G. L. Sullivan, "Forces That Are Reshaping a Big Market," *Printers' Ink* 92 (July 29, 1915): 26–28. Newmark (n. 57 above, p. 97) wrote in 1918 that it "has taken a quarter century for manufacturers to discover that they are making a utility." A 1930s study suggested that 80 percent of household automobile expenditures was for "family living"; see D. Monroe et al., *Family Income and Expenditures. Five Regions,* Part 2. *Family Expenditures,* Consumer Purchases Study, Farm Series, Bureau of Home Economics, Misc. Pub. 465 (Washington, D.C., 1941), pp. 34–36. Recall the 1925 survey of women's attitudes toward appliances (n. 41 above). The author of the report, Federation President Mary Sherman, concluded that "Before toilets are installed or washbasins put into homes, automobiles are purchased and telephones are connected . . . [b]ecause the housewife for generations has sought escape from the monotony rather than the drudgery of her lot" (p. 98). See also *Country Life* and Ward (n. 37 above); E. de S. Brunner and J. H. Kolb, *Rural Social Trends* (New York, 1933); and F. R. Allen, "The Automobile," pp. 107–32 in F. R. Allen et al., *Technology and Social Change* (New York, 1957).

ing strategy based on the experience of their "parent" technology; they stressed a limited and familiar set of uses; and they had to be awakened, it seems, to wider and more popular uses. The automobile producers learned faster.

No doubt other social changes also contributed to what I have called the discovery of sociability, and other explanations can be offered. An important one concerns shifts in advertising. Advertising tactics, as noted earlier, moved toward "softer" themes, with greater emphasis on emotional appeals and on pleasurable rather than practical uses of the product. They also focused increasingly on women as primary consumers, and women were later associated with telephone sociability.[59] AT&T executives may have been late to adopt these new tactics, in part because their advertising agency, N. W. Ayer, was particularly conservative. But in this analysis, telephone advertising eventually followed general advertising, perhaps in part because AT&T executives attributed the success of the automobile and other technologies to this form of marketing.[60]

Still, there is circumstantial and direct evidence to suggest that the key change was the loosening, under the influence of public practices with the telephone, of the telegraph tradition's hold on the telephone industry.

Conclusion

Today, most residential calls are made to friends and family, often for sociable conversations. That may well have been true two or three generations ago, too.[61] Today, the telephone industry encourages such calls; seventy-five years ago it did not. Telephone salesmen then claimed the residential telephone was good for emergencies; that function is now taken for granted. Telephone salesmen then claimed the telephone was good for marketing; that function

[59]Recall that, early on, women were associated in telephone advertising with emergencies, security, and shopping.

[60]On changes in advertising, see sources cited in n. 21 above. The comment on N. W. Ayer's conservatism comes from Roland Marchand (personal communication).

[61]It is difficult to establish for what purpose people actually use the telephone. A few studies suggest that most calls by far are made for social reasons, to friends and family. (This does not mean, however, that people subscribe to telephone service for such purposes.) See Field Research Corporation, *Residence Customer Usage and Demographic Characteristics Study: Summary*, conducted for Pacific Bell, 1985 (courtesy R. Somer, Pacific Bell); B. D. Singer, *Social Functions of the Telephone* (Palo Alto, Calif.: R&E Associates, 1981), esp. p. 20; M. Mayer, "The Telephone and the Uses of Time," in Pool, *Social Impact* (n. 2 above), pp. 225–45; and A. H. Wurtzel and C. Turner, "Latent Functions of the Telephone," ibid., pp. 246–61.

persists ("Let your fingers do the walking. . . . ") but never seemed to be too important to residential subscribers.[62] The sociability function seems so obviously important today, and yet was ignored or resisted by the industry for almost the first half of its history.

The story of how and why the telephone industry discovered sociability provides a few lessons for understanding the nature of technological diffusion. It suggests that promoters of a technology do not necessarily know or determine its final uses; that they seek problems or "needs" for which their technology is the answer (cf. the home computer business); but that consumers may ultimately determine those uses for the promoters. And the story suggests that, in promoting a technology, vendors are constrained not only by its technical and economic attributes but also by an interpretation of its uses shaped by its and their own histories, a cultural constraint that can be enduring and powerful.

[62]A 1934 survey found that up to 50 percent of women respondents with telephones were "favorable" to shopping by telephone. Presumably, fewer actually did so; see J. M. Shaw, "Buying by Telephone at Department Stores," *Bell Telephone Quarterly* 13 (July 1934): 267–88. This is true despite major emphases on telephone shopping in industry advertising. See also Fischer, "Women" (n. 41 above).