

FOURTEENTH ANNUAL REPORT

FEDERAL

COMMUNICATIONS

COMMISSION



FISCAL YEAR ENDED JUNE 30, 1948
(With Notation of Subsequent Important Developments)

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LETTER OF TRANSMITTAL

FEDERAL COMMUNICATIONS COMMISSION,
Washington 25, D. C., December 31, 1948.

To the Congress of the United States:

The Fourteenth Annual Report of the Federal Communications Commission, for the fiscal year 1948, is submitted herewith in compliance with section 4 (k) of the Communications Act.

This report is intended to give the Congress, the industry, and the public a comprehensive word-picture of the unprecedented expansion of radio and other electrical communication media and the responsibilities and activities of the Commission in dealing with attendant problems.

Since figures and situations in this field are never static, a summary of the more important developments since the close of the fiscal year is included for convenient reference.

Respectfully,

WAYNE COY,
Chairman.

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INTRODUCTORY SUMMARY

1. HIGHLIGHTS OF THE FISCAL YEAR
 2. SUBSEQUENT EVENTS
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1. HIGHLIGHTS OF THE FISCAL YEAR

The fiscal year 1948 emphasized the acuteness of the "housing" shortage which exists in the radio spectrum. It is becoming increasingly difficult to squeeze new stations into already congested bands, and to accommodate rapidly developing services. Until methods and equipment are available to use higher portions of the spectrum, present frequencies must be employed more effectively. Accordingly, in cooperation with industry, the Commission was engaged in reviewing and revamping existing radio services, and conducting engineering, and other studies looking to future adjustments.

Since frequency allocation and use is also an international problem, the Commission is playing an increasingly active role in world conferences directed toward uniformity of practices and usages made necessary by kaleidoscopic developments in the field of electrical communications. Besides doing a large share of the preliminary work, the Commission furnished delegates or advisers to 15 such sessions held during the year, and was preparing for 20 others in prospect.

The general public is familiar with broadcasting because it enters the home. But it has little acquaintance with the more than 50 other classes of radio stations, equally important in providing more than a hundred diversified nonbroadcast services, which outnumber program stations by more than 30 to 1.

As of June 30, 1948, there were nearly 131,000 authorized radio stations of all types, not counting associated mobile stations. In addition, various radio-operator authorizations approximated 505,000. Thus the Commission had over 635,000 radio authorizations on its books, which was an increase of about 85,000 during the year and more than 3 times the prewar number.

In the same period the Commission received in excess of 200,000 applications relating to radio. This is almost double the volume before the war. In addition there were more than 3,100 applications and nearly 30,000 tariff and other filings during 1948 in connection with Commission regulation of wire, cable, and radio common carriers engaged in international and interstate service. The Commission continued to simplify its forms and other licensing procedure

insofar as legal and technical requirements permit. There is no fee or other charge in connection with its licensing or other regulatory functions.

Broadcast authorizations increased 400 over the previous year, bringing the total number of stations in 10 categories to nearly 4,000. Of this figure, 3,163 were major broadcast outlets—2,034 amplitude modulation (AM); 1,020 frequency modulation (FM); and 109 television (TV). They represented a gain of 239 AM, 102 FM, and 43 TV stations.

The last half of the year witnessed a sudden surge in TV applications and a leveling off of FM requests. Applications for new TV stations for the year almost equaled the number for new AM facilities; FM seekers were less than half the TV number. Texas and California led all States in total outstanding broadcast authorizations in these three categories.

AM broadcast income in 1947 (the most recent year for which statistics were available) was less than the year previous, though the major networks showed a gain.

Slightly more than 1,100 AM stations were affiliated with the 4 Nation-wide networks, and there were more than a score of regional AM networks. Under the impetus of rebroadcast opportunities and expanding coaxial cable and microwave relay facilities, FM and TV networks were developing. Broadcast receivers of all types were nearing the 75,000,000 mark.

Noncommercial educational broadcast stations increased from 38 to 46 and international broadcast stations remained at 37. Television experimental stations jumped from 81 to 124. Remote pick-up and developmental stations decreased slightly.

The broadcast year was marked by authorization of a new broadcast service—facsimile—which was scheduled for commercial operation over FM stations beginning July 15, 1948. Facsimile had been on an experimental basis.

Safety and special radio services, as their designation implies, are devoted largely to safeguarding life and property—on the land, sea, and in the air—but also cover utilization of radio for industrial and business purposes. These activities were under skyrocketing attention and development.

Numerically more than 10 times larger than the broadcast service, the safety and special services saw nearly 11,000 new station authorizations during the year, bringing their total to over 47,000. What is more, nearly 150,000 mobile stations were covered in these nonbroadcast services.

The largest increase was felt in the aeronautical field which added nearly 5,000 radio stations, making a total of nearly 21,000. The

marine services gained over 3,000 stations, for a total of 15,000. More than 600 ship radar installations attested to the growing use of that navigational aid.

Police radio stations increased to over 4,100, fire stations to nearly 100, forestry stations to nearly 500, and special emergency to nearly 100. There were over 200 railroad radio stations, 75 transit utility stations, 24 stations for intercity buses and trucks, and taxicab operational stations grew to nearly 3,000.

In addition, some 3,000 stations were being used by industry—1,700 by utilities, 400 by petroleum pipe lines, 32 by lumber interests, and 750 others employed in connection with probing for oil, direction of motion pictures, relaying press messages, etc. Over 600 experimental stations were testing new equipment and techniques.

The safety and special services were in a particular state of flux due to changes necessitated by domestic and international developments. A new highway maintenance service was inaugurated during the year, which on June 30 had grown to 126 stations. Two new service groups were proposed—to cover land transportation and industrial uses of radio.

More than 57,000 applications attested to the mounting interest in the safety and special services. Requests for experimental authorizations looked to specialized uses which veritably extended "from the cradle to the grave." Thus, while one Texas applicant sought radio for his baby diaper pick-up-and-delivery service, a large Chicago cemetery wanted radio to direct funeral corteges.

Common carrier services had approximately a thousand radio authorizations, covering more than 900 experimental stations (of which nearly 800 were general mobile), and 27 fixed public telephone and 56 fixed public telegraph stations.

Telephone regulation by the Commission covers interstate and international service by the Bell system and 63 independent companies. The telephone industry experienced a record business in the fiscal year. The Bell system, which owns about 85 percent of all telephones in use, handled over 36,000,000,000 conversations. New interstate wire and cable telephone construction amounted to \$127,000,000. Gross telephone investment exceeded \$8,000,000,000.

The thirtieth million Bell telephone was installed at Marshalltown, Iowa, on June 29, 1948. This increased the number of Bell and independent telephones in service to more than 36,000,000. Some 2,200,000 of these instruments were in rural service. About 40 percent of farm homes now have telephones. However, in three southern regions five out of six farms are still without this service.

More than 65 percent of all Bell telephones and 33 percent of the independent telephones had been converted to dial operation.

There were no material interstate rate reductions during the year. However, State utility commissions had granted increases of \$138,000,000 in intrastate rates in 35 States during the postwar period, and requests for increases totaling \$66,000,000 were pending before utility bodies in 15 States.

During the year the Commission authorized the use of telephone recording devices, with appropriate tone-warning signal, subject to the filing of related tariffs by August 2, 1948.

At the year's close nearly 7,700 miles of coaxial cable, representing an investment of \$170,000,000 (including 1,435 miles approved in fiscal 1948 and estimated to cost \$42,500,000) had been authorized for the Bell coaxial cable system, to accommodate many types of communication services, including television. A microwave relay system between New York and Boston was inaugurated November 11, 1947, and New York-Chicago and other links were being built. Short-distance radiotelephone service to isolated places was growing.

Tremendous expansion took place in the mobile telephone service. Telephone carriers have made such service available in 60 cities and were completing installations in 22 other cities. Highway service was operating in the vicinity of 95 communities, and construction was under way in 37 additional areas.

Overseas telephone service was reestablished with four countries and made available for the first time with seven other countries. About 575,000 overseas radiotelephone calls were handled during the year as compared with 50,000 annually before the war. Telephone service with ships and aircraft was on the increase.

Telegraph regulation dealt mainly with the Western Union Telegraph Co., which has a monopoly in the domestic field, and with international radio and cable telegraph carriers.

New domestic telegraph facilities authorized during the year included 38,200 channel miles, at an expenditure of \$260,000, and lease of 70,500 channel miles for \$350,000 annually requiring terminal equipment costing \$367,137.

Western Union was carrying out its \$72,000,000 modernization program which, in addition to mechanization features, saw the completion of a microwave triangle connecting New York, Philadelphia, Washington, and Pittsburgh. Western Union had more than \$300,000,000 invested in plant and equipment. Its revenue messages increased to more than 220,000,000 in the calendar year 1947. In February 1948 the Commission prescribed annual depreciation rates to be used by Western Union for classes of depreciable land-line plant, on the basis of a study concluded by the Commission.

Over 700 requests for reduction of office hours or closure of offices were received from Western Union. In February of 1948 the Com-

mission proposed a standard to determine the conversion of company operated offices to teleprinter offices operated by nontelegraph agencies.

Repeal, during the year, of the Post Roads Act of 1866 resulted in the Federal Government losing the benefit of special telegraph rates on its domestic traffic, though priority continued to be given particular Government messages on specific request.

Cable and radio telegraph carriers handled more than 656,000,000 paid words in the calendar year 1947, which was a slight decrease from the year previous. Of the 1947 total, over 337,000,000 words were in out-bound traffic. New radiotelegraph circuits to Israel and the Dodecanese Islands were opened during the year.

To meet the urgent revenue needs of international telegraph carriers, the Commission in July of 1947 authorized out-bound rate increases aggregating \$5,485,000. On the further plea that most of the carriers were still losing money, the Commission in April of 1948 permitted additional increases amounting to \$3,188,000. The revised rates remained not in excess of 30 cents per full rate word.

Radio operators, in the various categories, increased more than 64,000 during the year, bringing their aggregate total to more than 500,000. The largest group comprised commercial operators—347,000. Amateur operators numbered nearly 78,000, and their stations about 78,500. As a convenience to civilian flyers, special authorizations to operate radiotelephone installations in their planes were issued at airfields. Such authorizations approximated 80,000.

Field engineering and monitoring activities, conducted through 33 field offices augmented by 21 monitoring stations, dealt primarily with technical supervision of radio operations, reduction of interference, and apprehension of illegal transmitters. Nearly 30,000 inspections were made, of which number over 16,700 were land stations and 12,500 were ship stations. More than 17,000 violation, advisory, and other notices were issued. One hundred and fifty-three illicit radio operations were traced and closed, an increase of 26 percent over the previous year. Violators ranged from irresponsible youth to willful oldsters. Operator examinations, largely given in the field, approached 100,000. Aid was given in 170 cases of lost planes.

Interference complaints handled in the field jumped from about 6,800 such cases in 1947 to over 22,000 last year. Of the latter figure, nearly 1,500 were of a major nature. Some sources of interference were traced to drawbridges, medical apparatus, industrial dryers, and even miniature aquariums.

Technical studies were conducted in the interest of improving present and future radio operations. They covered possibilities in the use of higher frequencies, effects of wave propagation, skywave reflections, ground conductivity, signal intensity, harmonics, directional

antenna, etc. In addition to continuing studies, 83 new projects were initiated. Such data, besides being useful to industry in developing apparatus, are guidance for the Commission in considering rules and engineering standards for the operation of new services.

Laboratory work featured the testing of new equipment submitted by manufacturers for type approval prior to being placed on the market. Thus, many potential interference problems can be dealt with before they materialize. In this way certain difficulties in connection with medical and industrial heating appliances were ironed out at the source, before they assumed larger proportions through operation.

2. SUBSEQUENT EVENTS

The Commission, on August 19, 1948, proposed changes in the multiple ownership rules affecting commercial broadcast stations which would limit ownership, operation, or control by the same interest to not more than 7 AM stations in the country as a whole, and overlapping interests or connections to not more than 14 AM, 12 FM, and 10 TV stations. These would be in addition to the present rules noted under Radio Broadcast Services. Oral argument was scheduled for January 17, 1949.

The situation in television with respect to interference and insufficient spectrum space below 300 megacycles, and the possibility of operating in the 475 to 890-megacycle band, was the subject of a hearing before the Commission September 20 to 23. Pending determination of future TV channel allocations, the Commission on September 29 ordered applications for new TV stations placed in the pending file. It subsequently scheduled engineering conferences for November 30 to December 2 to consider technical data in connection with proposed rule making on tropospheric propagation. As of October 1, the number of TV receivers had increased to 612,000.

The text of a tentative TV-allocation plan between the United States and Canada was made public July 7, and an agreement between those countries respecting FM, on August 19. As a result of objections voiced by the Commission to the Department of State on May 6 and September 9, Mexico was understood to have agreed deferring its proposed use of the frequency 540 kilocycles for a standard broadcast station pending clarification of the issue at the next North American Regional Broadcasting Conference. An engineering conference was called by the FCC for December 7 to 9 to discuss NARBA matters.

Rules to permit low-powered educational FM broadcasting became effective September 27 and, on October 21, the Commission granted the first construction permit for a noncommercial educational station with power of less than 10 watts, to Syracuse University.

Special temporary authorizations for AM broadcast stations were abolished as of August 16.

The rule which requires AM and FM broadcast stations to make certain performance measurements at least once a year was postponed for 1 year from August 1.

A number of broadcast issues mentioned in this report were the subject of hearing or oral argument before the Commission subsequent to the close of the fiscal year and their determination was still pending. Oral argument in the matter of origination of AM and FM programs (main studios) was held October 15, and on promulgation of rules governing lottery programs October 19. Hearing on broadcast editorializing was held November 1. Hearing on agreements between networks and affiliates for the sale of national spot advertising, which began November 29, recessed to January 3, 1949.

In the period between January 1 and August 31 there were 112 deletions of authorizations in the three major broadcast services—36 AM (including 3 licensed stations and 2 other stations on the air); 74 FM grants (including 2 stations on the air), and 2 TV grants.

As of November, Chicago had more authorized AM, FM and TV stations collectively (33) than any other city in this country—or the world. New York City was a close second with 32, followed in turn by Los Angeles, 29; Philadelphia, 23; Washington, 21; San Francisco, 19, and Boston, 16.

On September 20 the Midwest coaxial link between Buffalo, Cleveland, Toledo, Chicago, and St. Louis was made available for television relay, with microwave connections with Detroit and Milwaukee. Connection with the eastern system was scheduled for January 12, 1949.

Hearing on charges and regulations for television transmission services and rates of the American Telephone & Telegraph Co. and the Western Union Telegraph Co. resumed on September 29. On October 18 the Commission ordered determination of the regulations and practices of interconnections of TV facilities before considering the reasonableness and lawfulness of rates.

Proceedings affecting the General and Public Mobile, Land Transportation, Industrial and Public Safety Radio Services, and frequencies for their use, resulted in oral argument from October 6 to 15. Previously, on August 19, the Commission suspended further consideration of general mobile and industrial radio applications, formerly authorized on an experimental basis, pending final action on proposed rules involved in the previously mentioned proceedings. For the same season, it extended to November 1, 1949, the term of existing general mobile class 2 experimental licenses.

Further steps looking toward the use of individual transmitter-receivers for personal and private communication were taken by the Commission on August 13 in proposing rules to govern the Citizens Radio Service, and on September 29 in proposing a simple application form in that connection. Meanwhile, no licenses were being issued in this contemplated service, except on an experimental basis, until rule making is finalized.

The Commission designated for hearing and oral argument, on November 22, proposed amendments to the Rules and Regulations Governing the Ship Service and Commercial Radio Operators with respect to installation and use of radar equipment.

Harmonic and spurious emissions from all types of radio transmitting apparatus were considered at an informal engineering conference on August 10.

A hearing, which started August 9, obtained expressions by common carriers and other users of international services preparatory to the International Telegraph and Telephone Conference to be held at Paris in May 1949.

Revenue requirements of international communications carriers and the question of whether immediate additional rate increases are warranted were heard beginning November 15.

Western Union, on September 22, was granted a further 1-year extension (to September 27, 1949) to divest itself of international telegraph operations in compliance with conditions of the merger involving Postal in 1943.

On July 22 the Commission instituted an investigation into the applicability of section 314 of the Communications Act to the organization and operations of the American Cable & Radio Corp. System. Hearing began December 7.

To relieve the work load of Commissioners, proposal was made on August 19 that initial decisions be issued by hearing examiners or Commissioners presiding at hearings, and that motions presently handled by the motion's Commissioner, with certain exceptions, be acted upon by hearing examiners.

On October 20 and November 3 the Commission amended part 1 of its rules and regulations to reflect recent changes in nomenclature and organization.

As of October 31, 1948, outstanding radio authorizations exceeded 675,000, an increase of more than 39,000 in the four months since the close of the fiscal year. The figures, for services and groups, were:

Service	June 30, 1948	Oct. 31, 1948	Increase
Broadcast:			
Standard (AM).....	2,034	2,103	69
Frequency modulation (FM).....	1,020	996	(-24)
Television (TV).....	109	124	15
Television (experimental).....	124	168	44
Noncommercial educational.....	46	46	0
International.....	37	37	0
Facsimile.....	2	2	0
Remote pick-up.....	571	578	7
Studio transmitter (ST).....	9	22	13
Developmental.....	15	15	0
Total broadcast services.....	3,967	4,091	124
Nonbroadcast:			
Aeronautical.....	20,858	24,596	3,738
Marine.....	15,024	17,172	2,148
Police.....	4,137	4,308	171
Fire.....	85	97	12
Forestry.....	461	516	55
Highway maintenance.....	126	141	15
Special emergency.....	94	92	(-2)
Utility.....	1,656	2,025	369
Petroleum.....	412	515	103
Lumber.....	32	69	37
Other industrial.....	755	822	67
Railroad.....	204	235	31
Transit utility.....	77	83	6
Intercity buses and trucks.....	24	32	8
Taxicab.....	2,817	3,188	371
Experimental.....	652	555	(-97)
Total nonbroadcast services.....	47,414	54,446	7,032
Common carrier:			
General mobile.....	785	855	70
Experimental.....	128	127	(-1)
Fixed public telephone.....	27	27	0
Fixed public telegraph.....	56	56	0
Total common carrier.....	996	1,065	69
Operators:			
Commercial operators.....	347,803	363,000	15,197
Aircraft radiotelephone.....	80,000	91,368	1,368
Amateur operators.....	77,923	80,549	2,626
Amateur stations.....	78,434	81,170	2,736
Citizens (experimental).....	48	66	18
Total operators.....	584,208	616,153	31,945
Grand total.....	636,585	675,755	39,170

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CHAPTER I. GENERAL

1. FUNCTIONS
 2. COMMISSION
 3. STAFF ORGANIZATION
 4. PERSONNEL
 5. APPROPRIATIONS
 6. LEGISLATION
 7. LITIGATION
 8. HEARINGS
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1. FUNCTIONS

The Federal Communications Commission is charged by the Congress with regulating interstate and foreign communication by means of telegraph and telephone, also broadcast and other radio transmission. Its authority is derived from the Communications Act of 1934, as amended. This act created the Commission with broad supervisory powers in the field of electrical communications to the inclusion of certain functions previously exercised by various Government agencies.

These duties, in general, embrace supervision of common carrier land wire, ocean cable, and radio services; allocation of radio frequencies, and licensing of radio stations and radio operators; encouraging new uses for radio, particularly in promoting safety of life and property on the land, on the sea, and in the air; domestic administration of communication provisions of treaties and other international agreements to which the United States is a party; and, as in the recent war, coordinating the use of these communication media with the national security program.

2. COMMISSION

The work of the Commission is directed by seven Commissioners, appointed by the President and subject to confirmation by the Senate, who normally hold office for 7 years. The Commission functions as a unit, directly supervising all activities, with delegations of responsibility to boards and committees of Commissioners, individual Commissioners, and the staff. Policy determinations are made by the Commission as a whole.

On December 26, 1947, the President appointed Wayne Coy as chairman to complete the term of Charles R. Denny (resigned as of November 1, 1947) which expires June 30, 1951. Chairman Coy took office December 29, 1947. Commissioner Robert F. Jones was sworn

in September 5, 1947, for the term expiring June 30, 1954. He succeeded Ray C. Wakefield. On May 24, 1948, Miss Frieda B. Hennock was named to succeed Clifford J. Durr, who declined reappointment and whose term expired June 30, 1948. Taking office July 6, 1948, Miss Hennock is the first woman to serve as a member of the Commission. Her term is until June 30, 1955.

3. STAFF ORGANIZATION

There were no major changes in the staff organization of the Commission during the year. As of May 12, 1948, the nomenclature of administrative elements was changed to conform to the general Governmental pattern, i. e., "Department" became "Bureau," "Section" became "Branch," and "Unit" became "Section."

The Commission functions with five bureaus—Engineering, Accounting, Law, Secretary, and Administration—augmented by a Hearing Division, a Rules Committee, and an Office of Information. The Bureaus of Engineering, Accounting, and Law are, in effect, broken down into comparable divisions for coordinated operation. Organization of these bureaus is as follows:

Bureau of Engineering.—FM Broadcast, Television Broadcast, Standard Broadcast, Common Carrier, Aviation, Radio Operator and Amateur, Marine Radio and Safety, Field Engineering and Monitoring, Technical Information, Public Safety and Special Services, Laboratory, and Frequency Allocation and Treaty Divisions.

Bureau of Accounting.—Economics and Statistics Division (Common Carrier, Broadcast, and Special Studies Branches); Broadcast Division (Applications, Renewals and Annual Reports, and Hearings Branches); Rates Division (Tariffs and Telephone Rates, and Telegraph Rates Branches); Accounting Regulation Division (Development and Compliance, and Original Cost and Depreciation Branches); and Field Division.

Bureau of Law.—Safety and Special Services Division (Aviation and General Mobile, Marine Operation and Amateur, and Emergency, Experimental and Miscellaneous Branches); Broadcast Division (AM, FM, Renewals and Revocations, Transfer, Review, and Motions Branches); Litigation and Administration Division (Litigation and Administrative Branches); Common Carrier Division (Rate, International, Domestic Wire, and Domestic Radio Branches).

Bureau of the Secretary.—License, Service, and Records Divisions, and Minute and Library Branches.

Bureau of Administration.—Budget and Fiscal, Planning, and Personnel Divisions.

4. PERSONNEL

A total of 1,380 persons were employed by the Commission as of June 30, 1948. Of this number, 907 were in Washington and 473 in the field. The bureau figures were: Engineering 734, Accounting 162, Law 105, Secretary 276, and Administrative and miscellaneous 103.

5. APPROPRIATIONS

Appropriations received by the Commission for the fiscal year amounted to \$6,240,000, of which amount \$40,000 was for printing and binding.

6. LEGISLATION

There were no additions of substance to the Communications Act during the fiscal year 1948. However, on July 16, 1947, the President signed Public Law 193 (S. 816, 80th Cong., 1st sess.) which repealed the Post Roads Act of 1866, pursuant to which special telegraph rates, as fixed by the Commission, had been accorded the Federal Government on domestic traffic. Public Law 239, Eightieth Congress, first session, "To terminate certain emergency and war powers," was approved July 25, 1947. It repealed section 606 (h) of the Communications Act; repealed footnote 28 to section 351; and provided that section 353 (b) should be repealed as of July 1, 1948.

Public Law 772, "To revise, codify, and enact into positive law, title 18 of the United States Code, entitled 'Crimes and Criminal Procedure,'" was approved June 25, 1948. In the interest of uniformity in codification, it repealed section 316 of the Communications Act which prohibits the broadcasting of information concerning lotteries and other similar schemes and reenacted the same prohibition, with slight changes in language, for the purpose of codification as section 1304 of title 18 of the Code. Similarly, the last sentence of section 326 of the Communications Act which prohibits the utterance of any obscene, indecent, or profane language by means of radio communication was repealed and reenacted as section 1464 of title 18 of the Code.

In addition, Congress considered numerous proposed bills which would in some way amend the Communications Act or affect the functions of the Commission. The most important were the White bill (S. 1333) which would revise a major portion of the Communications Act, the Lemke resolution (H. J. Res. 78) which would require the Commission to allocate frequencies in the 50-megacycle band for commercial FM broadcasting, and the Johnson bill (S. 2231) which would limit the maximum power of any radio station to 50 kilowatts and also limit the normally protected skywave contour. Hearings were held on these bills and the Commission appeared and presented extensive testimony. Comments were also prepared on other proposed

legislation which would have a bearing on the Commission's functions.

7. LITIGATION

Any final order of the Commission is subject to judicial review in accordance with the appellate provisions of the Communications Act and the Administrative Procedure Act. Most appeals are in the broadcast field.

During the fiscal year, 21 cases involving the Commission went to various Federal courts. One was before the Supreme Court, 19 were before the Court of Appeals for the District of Columbia, and 1 was before the United States District Court for the District of Columbia. The Commission's decision was affirmed in the one Supreme Court case. The court of appeals upheld the Commission in 2 cases; reversed the Commission in 1 case, 2 were dismissed by agreement of the parties, and 14 were pending at the close of the year. In the district court case, judgment was entered for the Commission. The following cases are of particular interest:

Skywave cases.—These eight cases are discussed as a group since they are all appeals taken by the licensees of class I stations on clear channels who alleged that their stations would suffer daytime skywave interference by reason of the assignment of new stations operating daytime only on the same channel. In the first case, it was contended that the Commission's assignment of a daytime station on the channel presently assigned to station WJR prior to the determination of the clear channel hearing was improper in that it prejudiced WJR's desire to apply for permission to operate with increased power. Oral arguments on three cases were held in which the Commission contended that under its existing Rules and Standards of Good Engineering Practice appellants were not entitled to protection against daytime skywave interference and had not been deprived of a right to hearing contrary to constitutional or any other legal requirements. All of these cases were pending in the United States Court of Appeals for the District of Columbia at the close of the fiscal year 1947: *Wilson, Inc. v. Federal Communications Commission*, No. 9434, U. S. Ct. of Appeals, D. C.; *Courier Journal & Louisville Times Co., Inc. v. Federal Communications Commission*, No. 9502, U. S. Ct. of Appeals, D. C.; *National Life & Accident Insurance Co. v. Federal Communications Commission*, Nos. 9510 and 9511, U. S. Ct. of Appeals, D. C.; *WGN, Inc. v. Federal Communications Commission*, No. 9497, U. S. Ct. of Appeals, D. C.; *Crosley Broadcasting Corp. v. Federal Communications Commission*, No. 9501, U. S. Ct. of Appeals, D. C.; *WJR the Goodwill Station, Inc. v. Federal Communications Commission*, Nos. 9495 and 9496, U. S. Ct. of Appeals, D. C. On April 12, 1948, the court issued a decision in *L. B. Wilson v. Federal Communications Commission*, No. 9434, revers-

ing the Commission and remanding the matter for further proceedings. The seven remaining skywave cases were still pending at the end of fiscal 1948.

Hearst Radio, Inc. v. Federal Communications Commission.—This action involved a suit by Hearst Radio, Inc., licensee of radio station WBAL, Baltimore, Md., in the District Court for the District of Columbia for a declaratory judgment to have certain allegedly libelous matter deleted from the Commission's Report of March 7, 1946, entitled "Public Service Responsibility of Broadcast Licensees." Plaintiff requested a preliminary injunction, pending a determination of this case, prohibiting the Commission from proceeding with the processing of Hearst's application for renewal of WBAL's license which had been set for consolidated hearing with a mutually exclusive application for the frequency upon which that station has been licensed to operate. On February 19, 1947, the district court denied the Commission's motion to convene a three-judge court to hear the matter and granted the preliminary injunction sought by Hearst. On April 21, 1947, argument was held before the district court on a motion by the Commission to convene a three-judge court to hear the action or, in the alternative, to dismiss the action for want of jurisdiction. On July 3, 1947, the court entered an order granting the Commission's motion to dismiss the complaint. A notice of appeal was filed July 11, 1947, and the court of appeals affirmed the decision of the lower court January 12, 1948. *Hearst Radio Inc. v. Federal Communications Commission*, 167 F. 2d 225.

Allen T. Simmons v. Federal Communications Commission.—This case in the Court of Appeals for the District of Columbia is an appeal from a Commission decision and order which denied the application of Allen T. Simmons to increase power of radio station WADC, Akron, Ohio, from 5 to 50 kilowatts, and to change operating frequency from 1350 to 1220 kilocycles, and granted the mutually exclusive application of WGAR Broadcasting Co. to increase the power of Station WGAR, Cleveland, from 5 to 50 kilowatts, operating on 1220 kilocycles. The Commission denied the Simmons' application primarily on the grounds that operating as proposed he would not exercise the responsibility of a licensee in a manner consistent with the requirements of the Communications Act and would not serve the needs and interests of the region to be covered by the proposed station. The court affirmed the Commission's decision. (*Allen T. Simmons v. Federal Communications Commission*, U. S. Ct. of Appeals, D. C., April 28, 1948.)

Murray and Meyer Mester v. Federal Communications Commission.—This case arose upon the application of Wodaam Corp., licensee of radio station WOV, New York, N. Y., for permission to transfer control of the corporation to Murray and Meyer Mester. The appli-

cation was designated for hearing to obtain, among other things, "full information with reference to the qualifications of the proposed transferees." Upon the basis of the hearing record, which included evidence that the proposed transferees had been involved in several proceedings by various regulatory bodies of the Federal Government for violations of Federal law in the conduct of their edible oil business, and which reflected an extreme evasiveness and lack of candor in furnishing requested information, the Commission found that it would not be in the public interest to approve the transfer of control. The proposed transferees appealed to the District Court for the Eastern District of New York and the matter was heard before a special three-judge court as provided in section 402 (a) of the Communications Act. The court granted the Commission's motion for summary judgment February 4, 1947, in an opinion which held that the Commission was authorized to make a full inquiry into the character of a proposed transferee, including involvement in civil litigation and his disposition to be truthful, and to refuse an application for transfer of control if in the light of such inquiry it appears that such transfer would not be in the public interest. (*Mester et al. v. United States*, 70 F. Supp. 118.) This decision was appealed to the Supreme Court May 27, 1947. That court denied the appellant's motion for rehearing November 10, 1947. (*Mester v. Federal Communications Commission*, 332 U. S. 820.)

8. HEARINGS

The Commission has little or no control over the number of applications that are designated for hearing. Where two or more applicants request the same frequency, or it appears that undue interference would result, or if other serious questions are involved, a hearing is usually necessary before a determination can be made. No application can be denied without the opportunity for a public hearing. As the spectrum becomes more congested, the ratio of applications that require hearing increases.

Pursuant to the Administrative Procedure Act, the Commission has since May 28, 1947, maintained a separate Hearing Division with attorneys whose sole duty is to preside at hearings and prepare initial or recommended decisions.

Docket statistics for the fiscal year follow:

	Pending July 1, 1947	Designated for hearing	Disposed of without hearing	Disposed of following hearing	Pending June 30, 1948
Broadcast services.....	759	623	372	292	719
Safety and special services.....	17	29	15	2	29
Common carrier.....	26	20	11	14	21
Joint and general dockets.....	1	3	1	0	3
Totals.....	803	675	399	308	771

CHAPTER II. RADIO FREQUENCIES

1. RADIO SPECTRUM
 2. ALLOCATION OF FREQUENCIES
 3. INTERNATIONAL CONFERENCES
 4. FREQUENCY CHANGES
 5. FREQUENCY ALLOCATION AND TREATY DIVISION
 6. INTERDEPARTMENT RADIO ADVISORY COMMITTEE
 7. DOMESTIC FREQUENCY ALLOCATIONS AND RULES
 8. INTERNATIONAL TREATIES AND AGREEMENTS
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1. RADIO SPECTRUM

Radio, too, has its housing problem. New developments emphasize the still relatively small part of the electromagnetic spectrum which can presently be used for broadcast, common carrier, and other forms of electrical communication.

The lowest frequency now available for radio transmission is 10 kilocycles. This, then, is the bottom of the radio spectrum. Wartime research and developments have raised the usable ceiling to 30,000 megacycles (or 30,000,000 kilocycles). However, the present upper limit for commercial use is around 10,000 megacycles. This top can only be extended when new techniques and equipment are developed.

The spectrum below 30 kilocycles is known as the VLF (very-low frequency) range; from 30 to 300 kilocycles, LF (low frequency); from 300 to 3000 kilocycles, MF (medium frequency); 3000 to 30,000 kilocycles, HF (high frequency); 30,000 kilocycles to 300 megacycles, VHF (very-high frequency); 300 to 3000 megacycles, UHF (ultra-high frequency); 3000 to 30,000 megacycles, SHF (superhigh frequency), and 30,000 to 300,000 megacycles, EHF (extremely high frequency).

In a sense, the radio spectrum may be compared to a vertical ruler with fractions of inches marking off, but in irregular fashion, the relative positions of the different radio services. That portion of the spectrum between 10 and 550 kilocycles is used largely by radiotelegraph stations and stations which serve as radio beacons for aircraft and ships. The section between 550 and 1600 kilocycles is the familiar standard broadcast band. Between 1600 and 25,000 kilocycles are frequencies employed by shortwave broadcast; various special, experimental and developmental services; long-distance radiotelephone and radiotelegraph communication between various countries, ships at sea, and planes in the air. It is interesting to note that the space oc-

cupied by standard broadcasting is only one thirty-thousandth of the entire known radio spectrum.

2. ALLOCATION OF FREQUENCIES

The radio spectrum is one of the world's *greatest natural resources*. In order to insure that it will be used in an orderly manner so as to bring the maximum benefits to the greatest number of people, Congress has provided that in the United States and its territories and possessions no one may transmit interstate radio signals or energy without a Federal authorization. The Federal Communications Commission is the licensing authority for the nongovernmental radio services. The President, through the Interdepartment Radio Advisory Committee (IRAC), makes frequency assignments to United States Government radio stations.

A major task of the Federal Communications Commission is to allocate bands of frequencies to the various radio services. It would be wasteful and chaotic to attempt to operate a broadcast station on one frequency, a police station on the frequency immediately adjoining, an aircraft station on the frequency next to that, and a ship station on the next one. *There must be appropriate bands for each of the twoscore radio services with which the Commission deals, and within these bands assignments are made to individual stations.*

Thus, there must be separate bands for radio broadcasting, for aircraft radio, for ship radio, for police radio, for railroad radio, and other specialized services. Also, there must be bands for radar and other navigation aids. There must be portions of the radio spectrum in which scientific, industrial, and medical equipment can operate without interfering with communication services. There must be bands for international broadcast and bands for amateurs.

The big allocation problem today is that the demand has far outstripped the frequencies available. It is becoming increasingly difficult to squeeze new stations into existing bands. This has resulted in strong competition among the various radio services. The problem cannot be solved by creating more frequencies because all usable frequencies are assigned and most services can't move "upstairs" until new methods and equipment become available.

However, much can be done, and is being done, to use the limited available frequencies more effectively. Maximum utilization of the radio spectrum depends upon proper assignment of frequencies and upon proper use of the frequencies assigned. This entails propagation and other highly technical studies. It may even be necessary in time to use directional antennas in some services besides standard broadcast.

Assigning bands of frequencies to the different radio services is not

only a difficult problem, as far as our own country is concerned, but it is also an international problem. Radio transmissions cross international borders and, therefore, there must be coordination and agreement in their sharing. A foreign passenger plane arriving in this country must be able to talk on the same frequency band that an American carrier plane over Paris uses for communication. Likewise, British merchant ships cannot employ radar on the bands which the United States uses for television. Just as bands set aside for radiotelephone and radiotelegraph must be shared by stations of the United States with other stations throughout the world, so must ship bands, aviation bands, and international broadcasting bands also be used jointly.

3. INTERNATIONAL CONFERENCES

The Commission's role in international communication matters is a technical yet increasingly active one. Working through the Department of State, it is called upon to do a large share of the preparatory work for international conferences, to furnish a large proportion of the United States delegates and advisers to these conferences, and to maintain comprehensive records with respect to international treaties and other agreements which affect domestic telecommunications interests.

During the fiscal year 1948, the Commission participated in 15 international sessions here briefed:

International Telecommunication and Radio Conference, Atlantic City, N. J., May 15 to October 2 1947.—This, the most important session of its kind, harmonized existing world regulations with post-war developments. Representatives of 72 countries attended and the Chairman of the Federal Communications Commission presided. The revised agreements on telecommunications, replacing the Madrid Convention of 1932, and those on radio, replacing the Cairo Radio Regulations of 1938, will become effective January 1, 1949, except the allocation of frequencies below 27,500 kilocycles. The latter will not come into force until a date has been determined by a special Administrative Radio Conference which will meet to consider a new international frequency list being drafted by the Provisional Frequency Board at Geneva. However, all or any portion of the band 150 to 2,850 kilocycles may come into force in region 2, of which the United States is a part, on or after January 1, 1949, under special arrangements agreed upon by the interested countries in this region.

Preliminary NARBA (North American Regional Broadcasting Agreement) Conference, Havana, November 1947.—Agreement was reached on many engineering standards and technical definitions preparatory to the general NARBA conference in Canada in 1949.

ITU (International Telecommunications Union) Provisional Frequency Board, Geneva, January 1948.—Established by the Atlantic City meeting, this board is drafting a new international frequency list for submission to a conference March 3, 1949, at Geneva.

ITU Planning Committee on High-Frequency Broadcasting, Geneva, March to April 1948.—Also established by the Atlantic City conferences, this committee drafted an allocation plan for HF broadcasting. It will meet in Mexico City October 1, 1948, to consider replies to its proposals prior to the opening of a world-wide conference on October 22 following.

Preparatory Committee for the International Administrative Aeronautical Radio Conference, Geneva, April to May 1948.—Compiling world frequency requirements for the aeronautical mobile services in preparation for the International Administrative Conference.

International Administrative Aeronautical Radio Conference, Geneva, May to July 1948.—Studied the technical and operating requirements of aeronautical mobile communications on the basis of Atlantic City allocations.

CCIT (International Telegraph Consultative Committee), Brussels, May 1948.—A subsidiary of the International Telecommunications Union, it considered problems in the fields of telegraphy and facsimile.

UCIF (International Telephone Consultative Committee), Stockholm, June 1948.—Also associated with the ITU, this conference issued recommendations regarding international telephone operations.

Regional European Maritime Radio Conference, Copenhagen, June 1948.—Considered the needs of the maritime services in certain bands between 255 and 525 kilocycles.

Safety of Life at Sea, Committee of Experts, London, January to February 1948.—Considered coordination of activities in fields of aviation, shipping, and telecommunications respecting both sea and air, reporting to the United Nations and the ensuing Safety of Life at Sea Conference.

International Conference of Safety of Life at Sea, London, April to June 1948.—Revised the 1929 London convention.

ICAO (International Civil Aviation Organization).—The Commission furnished delegates or advisers to the *South Atlantic Regional Air Navigation Meeting at Rio de Janeiro in July 1947*; the *Caribbean Regional Meeting, Mexico City, in September 1947*; the *Personnel Licensing Division Meeting at Montreal in April 1948*; and the *European-Mediterranean Regional Air Navigation Meeting at Paris in May 1948*.

The Commission is also doing preliminary work for 20 other international conferences and meetings to be held in fiscal 1949:

International Radio Consultative Committee (CCIR), Stockholm, July 1948.

Second Meeting of Planning Committee on HF Broadcasting, Mexico City, October 1, 1948.

International Conference on HF Broadcasting, Mexico City, October 22, 1948.

Special Administrative Radio Conference for Approval of Frequency List being drafted by Provisional Frequency Board, Geneva, March 3, 1949.

Fourth Inter-American Telecommunications Conference, at a place to be selected in the Americas, March 1949.

Committee on Revision of International Telegraph Regulations, Geneva, January 1949.

Technical Study Groups of CCIF, The Hague, April 1949.

Joint Committee of CCIF and CCIT, Paris, May 1949.

International Administrative Telegraph and Telephone Conference, Paris, May 1949.

European Conference for Study of Bands 1605 to 2850, 3155 to 3400, and 3500 to 3900 kilocycles, Oslo, June 1949.

CCIF Meeting, Paris, June 1949.

Third NARBA Conference, Canada, September 1949. At the fiscal year's close, all countries except Cuba had agreed to extend the present agreement 2 years—to March 29, 1951.

ICAO Africa-South African-Indian Ocean Regional Air Navigation Meeting.

ICAO India-Southeast Asia Regional Air Navigation Meeting, New Delhi.

ICAO Middle East Regional Air Navigation Meeting.

ICAO South American Regional Air Navigation Meeting.

ICAO South Atlantic Regional Air Navigation Meeting.

ICAO South Pacific Regional Air Navigation Meeting.

ICAO Communications Division Meeting, Montreal.

ICAO Search and Rescue Division Meeting, Montreal.

4. FREQUENCY CHANGES

The fiscal year 1948 was a transition year for international communications matters. It was marked by efforts on the part of the United States Government and domestic industry to prepare for the programs adopted at the Atlantic City sessions.

Finalizing the Atlantic City agreements will involve years of preparation, various other conferences, and extensive adjustments in the use of the radio spectrum. However, the past year saw decision in numerous instances where service-allocation of radio frequencies was under review.

The original proposal of the Radio Technical Committee for Aeronautics for more space in the vicinity of 1,000 megacycles for the aeronautical radionavigation service was adopted substantially by the ITU internationally and by the Commission and the IRAC in the United States. This new allocation preceded the program of installation of a new system of aids to air navigation and traffic control. This would not have been possible without the required spectrum space being obtained at the expense of other radio services.

The deletion of television channel No. 1 (see "Television") resulted in that space, 44 to 50 megacycles, going to non-Government fixed and mobile services. This move prompted proposed reallocation of the mobile band 152 to 162 megacycles to implement the new maritime telephone frequency, suballocation of the bands 25 to 30, 450 to 460, 940 to 952, 9,800 to 10,000 megacycles, and proposal that the new fixed band 72 to 76 megacycles be used subject to no interference to television reception.

The problem of securing frequencies to satisfy the short-wave broadcasting requirements of even the principal nations, which was already serious 10 years ago, has increased both in magnitude and complexity. Before the war less than 20 countries were engaged in international broadcasting. Today 77 nations are either actively engaged in high-frequency broadcasting or have indicated intentions to enter this field.

At Atlantic City it was recognized that if high-frequency broadcasting were to continue, the frequencies would have to be assigned in accordance with a plan which would be acceptable to a majority of the countries. The need for international frequency sharing was unanimously agreed upon, as well as the need for the adoption of sound engineering and other technical standards governing the operation of HF broadcasting.

Although it may not appear on the surface that the international short-wave broadcasting has any appreciable effect on other services operating between 3 and 35 megacycles, the world situation in this field is such that today many frequencies assigned to services other than broadcasting in this region of the spectrum are constantly being subject to interference from foreign broadcasts. If this practice continues, it could prove dangerous to essential communications involving safety of life, such as aviation. The most feasible solution is world-wide planning of broadcasting between 3 and 30 megacycles.

The United States will be expected to play a leading role at the Mexico City High Frequency Broadcasting Conference. The United States has been the principal exponent of frequency assignments on a planned basis. The International Frequency Registration Board, which was established to succeed the Berne Frequency List, is a United

States idea. The Provisional Frequency Board, which is making the new frequency assignment plan for the radio spectrum, is a United States idea. The various specialized groups and conferences concerned with frequency assignments on an international basis, such as Maritime, Aeronautical and High Frequency Broadcasting Conferences, were all suggested by the United States delegations at Atlantic City.

The United States has consistently maintained that an HF broadcasting assignment plan could be developed on a technical basis, that a set of engineering principles could be established and adhered to by a majority of the countries of the world, that frequency sharing could be accomplished both on a timesharing and geographical basis, and that, in short, in this way it is possible to bring order out of the chaos now existing in the high-frequency bands.

5. FREQUENCY ALLOCATION AND TREATY DIVISION

It is not possible to centralize in one organizational unit all the international functions of the Commission. Therefore, personnel in various units perform such tasks as are adjunct to their duties in such fields as marine, aeronautical, common carrier, broadcasting, etc. However, coordination is achieved through a Frequency Allocation and Treaty Division, established November 3, 1947.

This division is responsible for continuously studying the use and allocation requirements of various radio services, maintaining the master record of all Government and non-Government frequency assignments within the United States, generally coordinating the Commission's work in connection with international conferences, and maintaining records regarding such conferences and treaties.

The division is Commission contact with the International Telecommunications Union and represents the Commission on the Interdepartment Radio Advisory Committee, Interdepartmental Committee on Scientific and Cultural Cooperation, Telecommunications Coordinating Committee, Joint Aviation Telecommunications Coordinating Committee, Washington Provisional Frequency Board Liaison Committee, and the International Meteorological Organization. It furnishes the entire secretariat for the IRAC and the WPFBLC.

6. INTERDEPARTMENT RADIO ADVISORY COMMITTEE

The IRAC, representing various Government departments and agencies, authorized a record number of frequency assignments to Government radio stations. It processed 11,471 requests, of which number 3,988 were regular assignments, 1,533 were deletions of regular assignments, 131 were changes in assignments, 3,322 were temporary

assignments, 2,089 were deletions of temporary assignments, and 408 were telephone approvals.

7. DOMESTIC FREQUENCY ALLOCATIONS AND RULES

On June 11, 1948, the Commission proposed amending part 2 of its General Rules and Regulations in conformity with the Atlantic City radio regulations and existing treaties and conventions, to define all currently recognized radio services and stations, and to list all domestic frequency allocations between 25 megacycles and 30,000 megacycles.

8. INTERNATIONAL TREATIES AND AGREEMENTS

In addition to the Atlantic City agreements, the United States is signatory to the following major treaties and conventions which are still in effect: Safety of Life at Sea Convention, London, 1929; International Communications Convention, Madrid, 1932; General Radio Regulations, Cairo, 1938; North American Regional Broadcasting Agreement, Havana, 1937; Radiocommunications Agreement, Santiago, 1940; and the Interim Agreement (Modus Vivendi), Washington, 1946. In addition, this country has regional arrangements with Canada and Mexico with respect to broadcasting and aeronautical and maritime radio communication. New agreements with Canada cover FM and television broadcast assignments in both countries to prevent mutual interference, as already in effect with respect to standard broadcasting. A more detailed listing will be found in the appendix to this report.

CHAPTER III. RADIO BROADCAST SERVICES

1. GENERAL
 2. STANDARD (AM) BROADCAST SERVICE
 3. FREQUENCY MODULATION (FM) BROADCAST SERVICE
 4. TELEVISION (TV) BROADCAST SERVICE
 5. NONCOMMERCIAL EDUCATIONAL BROADCAST SERVICE
 6. INTERNATIONAL BROADCAST SERVICE
 7. FACSIMILE BROADCAST SERVICE
 8. REMOTE PICK-UP BROADCAST SERVICE
 9. ST (STUDIO-TRANSMITTER) BROADCAST SERVICE
 10. DEVELOPMENTAL BROADCAST SERVICE
 11. BROADCAST STATISTICS
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1. GENERAL

BROADCAST REGULATION

Commission regulation of broadcasting may be divided into two broad phases.

The first of these deals with the allocation of spectrum space to the different kinds of broadcast services in accordance with international agreement, and the formulation of policies and promulgation of rules to carry out the intent of such treaties and the Communications Act. The latter function includes the establishment of engineering standards and regulations covering technical aspects of construction and operation.

The second phase is concerned more directly with individual stations, and embraces consideration of applications to build and operate; the assignment of specific frequencies, power, time of operation, and call letters; the periodical inspection of equipment and the technical aspects of operation; passing upon transfers and assignments of facilities, also the many varied changes in existing authorizations; modifying and renewing construction permits and licenses; reviewing the past general service of each particular broadcaster to determine whether it has been in the public interest; licensing radio operators; and otherwise discharging domestic regulatory responsibilities.

New station authorizations are also subject to Civil Aeronautics Administration approval of proposed transmitter sites and antenna systems to guard against interference to air navigation. There is collaboration with other governmental agencies, both federal and state, where their jurisdictions are involved.

Broadcast stations are not common carriers under the Communications Act. Consequently, the Commission is not empowered to pass upon charges for the use of time or for advertising, nor is it concerned

with matters of internal management. Since the Commission is charged by the act to grant renewals of licenses only if it determines that service is in the public interest, it is incumbent upon the Commission to inquire into the over-all past operation of stations in reaching such determination. This is done by inquiry, investigation, or formal hearing.

POSTWAR GROWTH OF BROADCASTING

The postwar growth of broadcasting is revealed in the fact that the total number of authorized AM (amplitude modulation), FM (frequency modulation) and TV (television) stations has more than tripled in the last 3 years. Figures on the number of stations licensed or initially authorized at the close of each of the past 6 fiscal years were:

	1943	1944	1945	1946	1947	1948
AM.....	912	924	955	1,215	1,795	2,034
FM.....	48	52	53	511	918	1,029
TV.....	8	9	9	30	66	109
Total.....	968	985	1,017	1,756	2,779	3,163

At the close of fiscal 1948 nearly 4,000 stations in 10 categories were authorized in connection with broadcast services (see detailed table at the conclusion of this chapter). This was an increase of more than 400 over the previous year. Most of this gain was in the major services—AM, 239; FM, 102; and TV, 43. This net gain was in spite of the fact that 47 AM and 80 FM stations and 1 TV station were deleted.

BROADCAST APPLICATIONS

During fiscal 1948 the Commission received a total of 7,700 broadcast applications, an increase of 2,364 over the previous year. These covered requests for new stations, changes in facilities, licenses, renewals, transfers, modifications, etc. The year closed with 2,555 such applications pending as against 2,209 on June 30, 1947. Assignment and transfer applications rose to 425, which is about 230-percent increase over the previous year. It is expected that this trend will continue because of the lack of additional frequencies for new installations. (See table at the conclusion of this chapter.)

The majority of applications involved AM, 4,033. The FM total was 2,343. The last half of the year saw a rapid rise in the number of television applications and a leveling off of FM requests. Applications for new TV stations almost equaled the number of those for new AM facilities; FM seekers were less than half the TV number.

BROADCAST HEARINGS

Most of the Commission's hearing work (see Hearings, ch. 1) is in broadcast matters—largely on AM applications. In the 27 months between the close of the war and January 1, 1948, the Commission authorized 1,054 new AM stations. Out of 1,022 of these cases, 162 or 15.9 percent were granted after hearing. Fifty-four new AM stations were granted in fiscal 1948 as the result of hearing, and 285 without hearing.

From VJ-day to June 30, 1948, a total of 1,061 FM authorizations were made. Because of the newness of this service, the general availability of frequencies and lack of interference problems usually associated with AM applications, only 80 or 7.5 percent required hearing. In the past fiscal year, 28 new FM stations were granted after hearing, and 182 without hearing.

Docket statistics involving all types of broadcast cases during fiscal 1948 follow:

	Pending July 1, 1947	Designated for hearing	Disposed of without hearing	Disposed of fol- lowing hearing	Pending June 30, 1948
AM.....	650	364	313	228	473
FM.....	98	45	32	58	53
TV.....	3	210	21	4	188
Other.....	8	4	6	2	4
Total.....	759	623	372	292	718

At the close of fiscal 1948, a total of 881 applications for new or changed AM stations were pending, of which number 401 (or 45.5 percent) were awaiting hearing. At the same time, pending FM applications of this nature aggregated 193, of which number 43 (or 23.3 percent) were in hearing. Like television applications amounted to 313, with 182 (or 57.8 percent) designated for hearing.

MULTIPLE OWNERSHIP

No change was made during the fiscal year in the existing rules which prohibit ownership operation of more than one AM, FM, or TV broadcast station in the same area, or more than six FM stations or five TV stations throughout the country as a whole. There was no over-all limitation on the number of standard broadcast stations. However, the Commission was considering substantive changes. (See Subsequent Developments.)

BROADCAST EDITORIALIZING

The Commission, in March and April of 1948, conducted an en banc hearing in the matter of editorializing by broadcast stations. It was held to determine "whether the expression of editorial opinions by

broadcast station licensees on matters of public interest and controversy is consistent with obligations to operate their stations in the public interest," also "the relationship between any such editorial expression and the affirmative obligation of the licensee to insure that a fair and equal presentation of all sides of controversial issues is made over their facilities." The hearing was ordered by the Commission on September 5, 1947, in view of "widespread discussion of the exact meaning" of its opinion of January 16, 1941, in the Mayflower Broadcasting Corp. case; "its application to particular situations, and the desirability or undesirability of having a general policy concerning editorializing by broadcast stations." Hearing was scheduled for November 1.

POLITICAL BROADCASTS

The legislative history of section 315 of the Communications Act "makes it abundantly clear that Congress did not intend licensees to have any right of censorship over political broadcasts," declared the Commission in a decision of June 28, 1948, relating to the Port Huron Broadcasting Co. (WHLS, Port Huron, Mich.) The particular section of that act reads:

If any licensee shall permit any person who is a legally qualified candidate for any public office to use a broadcasting station, he shall afford equal opportunities to all other such candidates for that office in the use of such broadcasting station, and the Commission shall make rules and regulations to carry this provision into effect: *Provided*, That such licensee shall have no power of censorship over the material broadcast under the provisions of this section. No obligation is hereby imposed upon any licensee to allow the use of its station by any such candidate.

The Commission stated that this particular censorship prohibition by Congress "appears clearly to constitute an occupation of the field by Federal authority which, under the law, would relieve the licensee (but not the actual speaker) for any libelous matter broadcast in the course of a speech coming within section 315 irrespective of the provisions of State law."

LOTTERIES

In the fall of 1947 the Commission ordered an individual station licensee to show cause why a certain program, which appeared to contain elements of prize and chance, did not constitute a violation of then section 316 of the Communications Act which prohibits the broadcast of any advertisement or information concerning any lottery or gift enterprise. Hearing was held in November 1947 and decision was pending at the close of the year. (See Legislation and Subsequent Developments.)

OTHER BROADCAST POLICY CONSIDERATIONS

Information that several broadcast stations had contracted for the sale of time to advertising agencies, which in turn marketed this time

to sponsors who arranged their programs, caused the Commission on August 11, 1947, to point out that the act holds the licensee responsible for the management and operation of his station and he cannot delegate that responsibility to another by contract or otherwise.

Observing that a number of transfers of station control had been consummated prior to obtaining Commission consent, the Commission on May 7, 1948, reminded licensees and permittees that a transfer cannot legally take place until after the Commission has given its approval.

On February 20, 1948, the Commission proposed rules (docket 8747) which would require the main studios of AM and FM stations to be located in the city for which the station is licensed. Oral argument on request of interested parties was scheduled for October 1948.

NETWORKS

The Commission does not license networks as such, but issues licenses to individual stations. However, stations owned or affiliated with networks are subject to the chain broadcasting regulations promulgated by the Commission in 1940.

The close of fiscal 1948 saw 1,105 AM stations affiliated with the 4 major networks as follows: American Broadcasting Co., 262; Columbia Broadcasting System, 172; Mutual Broadcasting System, 506, and National Broadcasting Co., 165. The number of stations wholly owned by these networks remained unchanged—ABC, 5; CBS, 7; MBS, 0; and NBC, 6—a total of 18. There were more than a score of regional AM networks, and FM and TV networks were developing.

BROADCAST STATION CONSTRUCTION COSTS

Estimates given on applications for new commercial broadcast stations indicate average current construction costs as follows: Standard and FM broadcast, each around \$50,000, including land and buildings; and television, \$200,000, exclusive of land and buildings. For both FM and TV stations, however, the cost range varies widely, depending upon whether metropolitan or community service is proposed, whether the stations will be built as adjuncts to AM stations, as well as a number of other factors.

On November 4, 1947, the Commission made available its Economic Study of Standard Broadcasting which indicated the rapid growth in the number of AM stations since the war and analyzed certain significant factors that might affect the future economic health of the industry. It was too early in the development of FM and TV to warrant similar studies in those fields.

GROUP INTERESTS IN BROADCASTING

Increasing interest in broadcast operation by religious, labor, and amusement groups was noted during the year. Various denomina-

tional churches, schools, and other institutions had acquired or were seeking AM and FM stations in many sections of the country. Labor groups were holders of or applicants for AM and FM grants in New York, Boston, Philadelphia, Cleveland, Detroit, Chicago, Los Angeles, and Chattanooga. Motion-picture and theater concerns evinced particular interest in television.

Newspaper ownership or affiliation, as of January 1, 1948, was indicated in 444 out of 1,887 AM authorizations; 331 out of 1,010 FM authorizations, and 24 out of 73 TV authorizations.

RECEIVING SETS

The Commission does not license broadcast receivers. From 60,000 sets in 1922, the total was nearing 75,000,000. Over 94 percent (about 37,000,000) of the families of the United States are said to possess receivers. It is estimated that an average of 30,000,000 individuals listen to radio sometime during each day and that the average daily listening per family is in excess of 4 hours.

Production of FM and TV receivers was increasing. Of nearly 8,500,000 receivers the industry reported having manufactured in the first 6 months of the calendar year 1948, a total of 770,000 were capable of receiving FM, and nearly 335,000 others were for TV reception. The figures for 1947 (12 months) were 1,175,104 FM and 178,571 TV sets out of a total of 14,666,040 of all types. Many of the new TV sets contain FM or AM bands, or both.

2. STANDARD (AM) BROADCAST SERVICE

GENERAL

The demand for standard broadcast facilities continued during the fiscal year, but abated somewhat from its peak in early 1947. From an engineering viewpoint, desirable AM facilities are becoming scarcer, with unlimited time facilities practically nonexistent, and daytime only facilities extremely hard to find in the more heavily populated areas of the country.

However, the number of AM stations increased 239 during the 12-month period, bringing their total as of June 30, 1948, to 2,034. Most of the 4,033 AM applications received involved changes in facilities, licenses and renewals, transfers, etc.

As of January 1, 1948, 133 communities had 4 or more AM stations.

DEVELOPMENTS

Probably the most important developments in the standard broadcast field during the past year are associated with the clear channel allocation problem and the North American Regional Broadcasting Agreement.

The record in the long-standing clear-channel proceeding (docket 6741), begun in early 1946, was completed in October 1947. Subsequent to the adjournment of the clear-channel hearing on October 31 of that year, the matter was consolidated with docket 8333 which deals with the related problem of daytime skywave transmission. Oral arguments in both dockets were held before the Commission January 19 to 21, 1948.

CLEAR CHANNELS

The clear-channel principal has been inherent in the American system of broadcasting from its early beginnings. It concerns a limited number of the standard broadcast channels set apart for the operation of high-powered stations with extensive areas protected against interference.

Of the 106 available AM channels, 59 have been set apart for clear channel broadcasting in North America. A high degree of protection is afforded the United States on 46 of them, with priority for protection on the remaining 13 going to other North American countries. This allocation practice has been heretofore justified as a means of providing broadcast service to widespread sparsely populated rural areas.

Of the 46 clear channels used in this country, 24 are each occupied by only one station at night, with all foreign assignments so restricted that the interfering signal at the border does not exceed an objectionable level. The other 22 clear channels may have several stations operating at night with less extensive protected areas.

Exclusive nighttime operation versus shared nighttime operation has long been a subject of spirited controversy among and between broadcasting groups, and it is this issue around which all other issues in the clear channel proceedings revolve.

Sixteen of the 24 domestic stations with exclusive night operation have formed an association which strongly advocates Commission rules that would permit exclusive night operation with power of 750 kilowatts as a means of providing a reasonably satisfactory broadcast service to 22,000,000 rural listeners. On the other hand, an association of regional stations spearheads a group contending that the present power limitation of 50 kilowatts should be retained and protection on the 24 exclusive channels should be relaxed so as to permit operation at night by more than one station.

The consolidated dockets now contain approximately 6,700 pages of testimony, 421 exhibits and voluminous briefs. The Commission had hoped to reach a decision which could be reflected in United States proposals for a new North American Regional Broadcasting Agreement. Shortly after the close of arguments in January of 1948, the United States Senate Interstate and Foreign Commerce Committee commenced consideration of the Johnson bill (S. 2231) which pro-

posed to keep the power of standard broadcast stations to the 50-kilowatt maximum and provide for duplication of clear channels. Inasmuch as the question of power limitation is one of the basic issues in the clear-channel proceeding, the committee requested the Commission to withhold decision pending disposition of the bill.

The Commission felt that decision in the clear-channel matter is a necessary preliminary to formulating proposals for a new North American Regional Broadcasting Agreement and, therefore, in the early part of 1948 requested the Department of State to propose postponement of the scheduled Canadian conference for at least 1 year and to extend the present NARBA for 18 months. At about the same time Mexico proposed a 1-year postponement of the conference and a 2-year extension of the agreement. As a result all signatory countries have agreed to delay the conference until September 1949, and at the close of the fiscal year all except Cuba had agreed to extension of the existing agreement until March 29, 1951.

A record of the testimony and other data considered by the Senate committee in connection with the Johnson bill comprises a 1,586-page document. Although this bill was not acted upon by the Eightieth Congress, controversy over the power question continues. The Commission feels that a decision before the 1949 NARBA conference is imperative.

540 KILOCYCLES

One additional repercussion from the postponement of the NARBA session concerns the use of 540-kilocycle frequency for standard broadcasting. The AM broadcast band presently employed in the United States is 550 to 1600 kilocycles. Subject to regional agreement on the details of its use, 540 kilocycles was made available for broadcasting in the North American Region at the 1947 Atlantic City radio and telecommunications conferences.

The Department of State and the Commission feel that the addition of 540 kilocycles to the United States broadcast band must necessarily be delayed until agreement is reached with the other countries of North America. Accordingly, no plans for its domestic use have yet been adopted. Mexico, however, has seen fit to make an assignment on 540 kilocycles which would severely curtail any possible use of that frequency by United States stations. The assignment has been protested by the United States Department of State.

SPECIAL TEMPORARY AUTHORIZATIONS

The general trend of AM stations to use special temporary authorizations to operate beyond the hours for which they are licensed caused the Commission, on June 27, 1948, to abolish such authorizations, beginning August 16 following. This decision was the result of rule-

making proceedings. There was evidence that special temporary authorizations to daytime or limited time stations had been used to such a degree that night service by full-time stations was suffering considerable degradation.

SMALL LOCAL OUTLETS EXPAND

One significant aspect of the postwar expansion of radio stations has been the extension of standard broadcast facilities into small- and medium-sized communities. The table below shows the number and percent of communities of specified population size having one or more authorized **AM** radio stations as of October 8, 1945, and as of June 30, 1948:

Population size	Total number of communities in the United States (1940 census) ¹	Number and percent of total communities with 1 or more authorized radio stations			
		On Oct. 8, 1945		On June 30, 1948 ²	
		Number	Percent	Number	Percent
2,500 to 5,000.....	1,134	27	2.4	208	18.3
5,000 to 10,000.....	678	86	12.7	306	45.1
10,000 to 25,000.....	413	204	49.5	342	82.8
25,000 to 50,000.....	122	109	89.3	122	100.0
Over 50,000.....	140	140	100.0	140	100.0
Total.....	2,487	566	22.8	1,118	45

¹ The number of communities in each of the population groupings under 50,000 is derived from 1940 census data, excluding communities forming part of metropolitan districts. Each metropolitan district is counted as a single-radio community for purposes of this tabulation. A metropolitan district is defined as including a central city or cities with a population of 50,000 or more and the contiguous areas having a population of 150 or more persons per square mile.

² Includes 46 communities with FM stations only; all other communities have 1 or more AM stations.

³ Includes 59 communities of less than 2,500 population in 1940.

STANDARD BROADCAST FINANCIAL DATA

The following table shows comparative financial data for the standard broadcast networks and stations in the calendar years 1946 and 1947:

Networks and standard stations	1946, 8 networks, 1,025 stations	1947, 7 networks, 1,464 stations	Percent increase or (decrease)
Investment in tangible broadcast property:			
Cost to respondent.....	\$107,790,819	\$129,497,615	20.14
Depreciation to date under present owner.....	51,365,253	46,371,185	(9.72)
Depreciated cost.....	56,425,566	83,126,430	47.32
Revenues from sale of network time.....	134,781,108	134,726,631	(.04)
Revenues from sale of nonnetwork time.....	199,297,806	239,360,055	20.10
Commission paid representatives, etc.....	45,469,650	47,969,521	5.50
Revenues from sale of talent, etc.....	33,943,507	37,597,222	10.76
Total broadcast revenues.....	322,552,771	363,714,387	12.76
Total broadcast expenses.....	246,086,525	291,918,447	18.62
Broadcast income.....	76,466,246	71,795,940	(6.11)

The following table compares the 1946-47 broadcast revenues, expenses, and income of the four Nation-wide networks and their key stations:

Four Nation-wide networks and their key stations	1946	1947	Percent increase or (decrease)
Number of key stations.....	10	11	
Total broadcast revenues.....	\$86,494,599	\$91,232,718	5.48
Total broadcast expenses.....	71,708,921	75,091,412	4.72
Broadcast income (before Federal income taxes).....	14,785,678	16,141,306	9.17

The distribution of the 1947 broadcast revenues and broadcast income (before the Federal income taxes) as between networks and stations is shown in the following tables:

Distribution of total broadcast revenues, 1947

	Amount	Percent of total	Amount	Percent
Networks, including 27 owned and operated stations.....			\$104,407,721	28.7
Networks and their 11 key stations.....	\$92,670,766	25.5		
16 other network owned and operated stations.....	11,736,955	3.2		
1,437 other stations.....			259,306,666	71.3
971 stations serving as network outlets.....	208,495,683	57.3		
466 stations not serving as network outlets.....	50,810,983	14.0		
Total broadcast revenues.....			363,714,387	100.0

Distribution of broadcast income (before Federal income taxes)

	Amount	Percent of total	Amount	Percent
Networks, including 27 owned and operated stations.....			\$19,573,573	27.3
Networks and their 11 key stations.....	\$16,244,688	22.6		
16 other network owned and operated stations.....	3,328,885	4.7		
1,437 other stations.....			52,222,367	72.7
971 stations serving as network outlets.....	48,194,654	67.1		
466 stations not serving as network outlets.....	4,027,713	5.6		
Total broadcast income (before Federal income taxes).....			71,795,940	100.0

Because of the substantial number of new stations in their early and less profitable months of operation included in 1947, trends in the data given above may not correspond to the experience of "old" stations. For this reason, comparative data for the 2 years are presented below for identical stations, i. e., for stations which were in operation in both years and which did not change their status during the period with respect to class, time, and whether or not affiliated with a network. The data are shown in terms of averages per station of broadcast revenues, expenses and income for each class of station, excluding the Nation-wide networks and their 11 key stations.

Standard broadcast stations (excluding 11 key stations of Nation-wide networks)	1946	1947	Percent increase or (decrease)
Averages per station:			
Clear channel 50-kilowatts unlimited:			
Number of stations, 41			
Total broadcast revenues.....	\$1,225,807	\$1,261,878	2.94
Total broadcast expenses.....	\$829,767	\$894,367	7.79
Broadcast income.....	\$396,040	\$367,511	(7.20)
Clear channel 50-kilowatts part-time:			
Number of stations, 3			
Total broadcast revenues.....	\$964,239	\$1,092,125	9.85
Total broadcast expenses.....	\$772,491	\$821,111	6.29
Broadcast income.....	\$221,748	\$271,014	22.22
Clear channel 5- to 20-kilowatts:			
Number of stations, 126			
Total broadcast revenues.....	\$444,939	\$501,004	12.60
Total broadcast expenses.....	\$374,025	\$417,185	11.54
Broadcast income.....	\$70,914	\$83,819	18.20
Regional unlimited:			
Number of stations, 274			
Total broadcast revenues.....	\$345,986	\$359,596	3.93
Total broadcast expenses.....	\$246,975	\$267,019	8.12
Broadcast income.....	\$99,011	\$92,577	(6.50)
Regional part-time:			
Number of stations, 48			
Total broadcast revenues.....	\$170,276	\$177,845	4.45
Total broadcast expenses.....	\$139,426	\$148,144	6.25
Broadcast income.....	\$30,850	\$29,701	(3.72)
Local unlimited:			
Number of stations, 408			
Total broadcast revenues.....	\$113,551	\$122,113	7.54
Total broadcast expenses.....	\$86,889	\$98,408	13.26
Broadcast income.....	\$26,662	\$23,705	(11.09)
Local part-time:			
Number of stations, 12			
Total broadcast revenues.....	\$68,305	\$79,649	16.61
Total broadcast expenses.....	\$53,421	\$60,772	13.76
Broadcast income.....	\$14,884	\$18,877	26.83
All stations:			
Number of stations, 812			
Total broadcast revenues.....	\$264,694	\$278,181	5.10
Total broadcast expenses.....	\$192,756	\$210,755	9.34
Broadcast income.....	\$71,938	\$67,426	(6.27)

¹ Includes 1 part-time station.

NOTE.—All broadcast income is before Federal income taxes.

3. FREQUENCY MODULATION (FM) BROADCAST SERVICE

FM CONTINUES TO GROW

Frequency modulation (FM) broadcasting continued to expand and furnished a considerable portion of the program service available to the public. This static-free and high-fidelity type of broadcast can now be heard in most of the populous areas of the country.

During the year the number of commercial FM stations on the air increased nearly 2½ times—jumping from 238 to 587—and at its close several hundred other FM stations were in various stages of construction. The number of authorized stations rose from 918 to 1,020. Either figure exceeds the total of all AM stations before the war.

The FM band (for commercial and educational broadcast) consists of 100 channels, 200 kilocycles wide, occupying that portion of the radio spectrum from 88 to 108 megacycles.

FM APPLICATIONS

The rate of filing applications for new FM stations decreased from the peak reached shortly after the war, and the year closed with 90 applications pending.

Initially, the majority of FM applications were from urban places, particularly large cities where the demand for facilities exceeded the number of frequencies available. In most areas of the country, though, the number of FM channels is adequate. This has resulted in some potential FM broadcasters preferring to wait until FM receivers are more widely distributed. However, a number of new FM stations are being established to serve areas largely rural in character.

NETWORK OPERATION

As far as FM network operation is concerned, the Commission believes that, in general, common carrier facilities—telephone or microwave—will be used for this purpose. On May 6, 1948, it proposed to permit intercity relay of FM programs on frequencies allocated for FM studio-link-transmitter purposes (940 to 952 megacycles). At the same time, it pointed out that there is nothing in its rules to prevent FM stations from rebroadcasting the programs of other FM stations, as is being done in some regions. In 1948 most FM network broadcasting was over 5,000-cycle wire lines used for AM network operation.

Telephone rates for 15,000-cycle intercity FM transmission became effective February 18, 1948. Such relay is possible over three types of wire circuits, including coaxial cable.

About half a dozen regional FM networks were operating or proposed.

AM DUPLICATION OVER FM STATIONS

Of importance to the development and public acceptance of FM broadcasting was the agreement reached in January 1948, between standard broadcast networks and the musicians, under which AM musical programs may be duplicated over FM stations without extra cost or additional programming personnel. As a result, listeners found many of their favorite programs on FM for the first time. FM stations associated with AM stations may be separately programmed or not, or in any combination of hours, as desired by the licensees. Of the 1,020 FM authorizations, approximately 800 were held by AM licensees or permittees.

FM LICENSE PERIOD INCREASED

Effective May 1, 1948, the Commission extended the normal license period of FM stations (both commercial and noncommercial) to 3 years after an initial system of expiration dates to fit a staggered schedule for renewal of licenses. The previous FM licensing period was 1 year. This not only recognized the stature of FM but helped to reduce the Commission's work load.

FM CONSTRUCTION

The Commission continued its policy of encouraging FM stations to start operation with interim equipment pending completion of full

construction. This was done to foster the expansion of FM and permit FM broadcasters to begin programming while awaiting the delivery of higher-powered equipment. In consequence, about half of the FM stations on the air were using less than their full authorized power.

In some cases permittees have been dilatory in constructing stations. The Commission has granted them extensions of time on the condition that construction be completed or interim operation commenced within the additional time authorized. A few construction permits were surrendered as a result of this requirement. Some permits have been relinquished because of increased construction costs and limited initial revenue in a new service.

The production of FM transmitters, antennas, and associated equipment increased rapidly during the year. At its close, almost any equipment desired was available from stock or on short notice. FM transmitters are usually built in units so that higher-powered amplifiers may be added as desired or as they become available.

As of June 1948, the practice of making FM conditional grants preliminary to issuing construction permits was abandoned because processing procedure and other considerations no longer made this temporary expediency necessary.

FM RECEIVERS

Approximately 2,000,000 FM receivers were estimated to be in use as of July 1, 1948. They were becoming available in quantity in practically all price ranges. In addition, numerous tuners could be had at reasonable prices for adapting AM receivers to FM reception. The year saw the appearance of table-model combination AM-FM receivers selling for \$50 or less. While receivers in this price range do not provide the tonal quality found in more expensive console models, they do furnish FM reception that is comparatively free from static and other interference.

4. TELEVISION (TV) BROADCAST SERVICE

SURGE IN TELEVISION APPLICATIONS AND SERVICE

As a result of television receivers, transmitters, cameras, and other associated equipment becoming plentiful, and the increased public interest in visual radio, there was an unprecedented surge in the number of applications for new TV stations.

At the end of the year 7 TV stations were licensed, 102 construction permits outstanding, and 294 applications pending. In addition to those licensed, 21 stations were operating on an interim basis. In consequence, 30 stations were bringing television broadcast service to 17 cities and metropolitan districts, as compared with 8 cities served by 12 stations the previous year. The demand for television facilities

was so much greater than the available allocated channels that 181 of the pending 294 applications had been designated for consolidated hearings at the end of the year.

The Commission continued to relax its requirement of a minimum of 28 hours of program service by each station per week. However, on June 17, 1948, it adopted a new rule which specified a graduated minimum hours of operation required of each station, ranging from 12 hours per week to 28 hours per week, depending on how long the station has been on the air.

It is interesting to note that currently there were only two television stations in operation abroad—both on an experimental basis in England where 60,000 TV receivers were reported in use. Subsequently, a French station started operating.

EXPERIMENTAL TELEVISION SERVICE

Television experimentation and research continued at a rapid pace. This was especially true of work in the ultrahigh and superhigh frequencies. Studies included propagation studies, development of equipment, new and more simple circuits, color transmission, and the system of relay broadcasting from planes in flight known as "stratovision." Several organizations were testing the band from 475 to 890 megacycles, which has been set aside for experimental television research and were making comparative studies in propagation, reception, reflections, and shadow effects with respect to these subjects in the "low" present black-and-white television band. One applicant was granted a construction permit for a 50-kilowatt experimental television station to be operated in this high band. Several broadcasters built and operated their own microwave relay networks so as to be able to relay events (notably sporting events) to the "mother" broadcasting station. These relay networks included intercity relay systems.

At the end of the fiscal year there were 87 experimental television stations licensed and 37 outstanding construction permits. Included in these figures were 99 relay stations used primarily as remote pick-up, studio-to-transmitter links, and intercity relay transmitters.

OTHER TELEVISION DEVELOPMENTS

An important stimulus to the television industry was actual or imminent extension of the coaxial cable system, and expansion of common carrier and television broadcast microwave relay systems. This is enabling more stations to carry network programs, has hastened the construction of others, and prompted more applications for television facilities.

However, television program relay was still confined to the East. The coaxial cable link between New York and Washington, the only

one presently used for TV transmission, was extended north to Albany, N. Y., and south to Richmond, Va. Microwave circuits which could be used for television existed between Boston and New York, New York and Schenectady, New York and Philadelphia, and Philadelphia and Washington. Coaxial or microwave links were in prospect for Buffalo, Toledo, Detroit, Chicago, Milwaukee, and St. Louis. (See also Coaxial Cable and Microwave Relay in chapter on Common Carriers.)

New techniques were developed in camera pick-up, especially in sporting events. The complete coverage of the political conventions and the wide relaying involved was one of the important television events of the year. These telecasts were carried into areas which did not have local TV service, such as Pittsburgh, by means of the strato-vision experiments. In a few parts of the country, motion-picture companies tried out the technique of picking up sporting and other events, relaying them by microwave relays and then showing the pictures on large screens in motion-picture theaters.

TELEVISION RECEIVERS

Television receiver production continued to mount to about 50,000 per month at the end of the fiscal year. Many new and low-priced models appeared on the market. It was estimated that some 460,000 TV sets had been produced since the close of the war.

TELEVISION CHANNEL ALLOCATIONS

With only 12 television broadcast channels presently available and the demand increasing, the whole television allocation problem had to be studied with a view of supplying an equitable distribution of service throughout the country, and also maintaining decent standards of good engineering practice.

The commercial TV band had consisted of 13 channels, each 6 megacycles wide interspersed between 44 and 216 megacycles. Part 3 of the Commission's Rules and Regulations contained a table of allocations of television channels which included only the first 140 metropolitan districts as defined by the Census Bureau. The upswing in television interest caused the Commission to call a hearing for June 14, 1948, on the matter of amending the allocation table. Over 80 appearances were filed, most of which were accompanied by petitions and engineering studies concerning additions of channels and other changes. Many supported the new allocation table proposed by the Commission. Oral argument on the above proceeding was still pending at the end of the year.

As a result of hearing and oral argument, the Commission as of June 14, 1948, made effective its proposed rule-making of August 14,

1947, which action deleted channel No. 1 (44 to 50 megacycles) from television broadcasting, abolished the sharing of television channels by certain other services, and provided the 72 to 76 megacycle band, a potential source of interference to television, to non-Government fixed and mobile services on an engineering basis of noninterference to television.

The loss of this channel to television, coupled with the mounting demand for television stations, was the basis for an over-all study by the Commission of the needs of television broadcast service for a satisfactory Nation-wide competitive coverage. Its engineering findings indicated briefly that there was insufficient spectrum space below 300 megacycles to make possible a truly Nation-wide competitive television system and that some interference to television reception would result from adjacent channel operation of other services, from harmonic radiations, and noises from other electrical devices. In view of this, the Commission on May 5, 1948, called for a hearing to obtain full information concerning interference to television reception in the present band, data concerning propagational characteristics of the 475 to 890 megacycle band, the state of development of transmitting and receiving equipment for this band, and any proposals for the commercial utilization of this band for television broadcasting. The date set for the above hearing was September 20, 1948. (See Subsequent Events.)

5. NONCOMMERCIAL EDUCATIONAL BROADCAST SERVICE

The FM broadcast band includes 20 channels (between 88 and 92 megacycles) allocated for use by noncommercial educational broadcast stations. These are licensed principally to universities and school systems for providing educational and entertainment programs to schools and to the public without profit.

Although the number of such stations on the air increased from 8 the previous year to 22 on June 30, 1948, the total number of stations authorized increased but slightly, from 38 to a total of 46. Eight additional applications for new stations were pending. While many educational institutions express interest in this service and indicate that they intend to establish stations, postwar problems facing many educators have delayed the fulfillment of these desires. Lack of sufficient appropriations by school systems has been a particular deterrent.

On June 17, 1948, the Commission issued proposed rules which would permit noncommercial educational FM stations to operate with a power of 10 watts or less, thus enabling stations to be established with a bare minimum of equipment costing only a few thousand dollars. The feasibility of low-power operation was successfully demonstrated over a period of a year by an experimental 2½-watt

station at Syracuse University. The Commission believes that low-cost stations, normally covering a radius of about 2 to 5 miles, will encourage the use of FM broadcasting by educational institutions. The equipment may be supplemented with higher-power amplifiers when and if desired.

While a number of States are planning to build state-wide FM educational networks, Wisconsin leads the field in this respect. It has two stations in operation and two others under construction. When several additional proposed stations are completed, nearly all citizens in that State will be within range of one or more of its educational FM stations.

FM sets for commercial program reception can also tune in local educational FM stations.

6. INTERNATIONAL BROADCAST SERVICE

International broadcast stations operating in this country are licensed by the Commission, but function under the auspices of the Department of State. Their programs are directed and supervised by the International Broadcasting Division of the Office of International Information and Educational Exchange of that Department. Programs in many languages were beamed overseas daily. The number of stations—37—remained unchanged.

7. FACSIMILE BROADCAST SERVICE

An important new commercial broadcast service—facsimile—was authorized during the year.

Following hearings, the Commission in June 1948 adopted rules providing for commercial facsimile broadcasting by FM stations beginning July 15, 1948. FM stations, in consequence, may transmit printed matter and pictures for reception by anyone having a facsimile receiver and recorder within the station's service area. Limited quantities of facsimile transmitting and receiving equipment are in production and more will be available as the service develops.

Previously, all facsimile had been of an experimental nature. During the past several years facsimile apparatus and techniques improved greatly. The Commission found that the service was adequately developed to be established on a regular basis with the other commercial broadcast services. Several FM stations have already begun transmitting facsimile under the new rules and standards.

Since facsimile transmitters and receivers must be synchronized, transmission standards are necessary so that any facsimile receiver may operate from any facsimile station in its area. There was little difference of opinion in the industry concerning the standards proposed for adoption, with the exception of the recorder line length to be em-

ployed. While the majority favored the 8.2-inch paper size, there was some support for 4.1-inch paper operating at the same speed of 105 lines per inch (3.43 inches per minute).

The Commission shared the view that the larger size should be used and adopted standards accordingly. These provide for the transmission of 16 letter-size pages per hour. However, different size recorders may be employed if the number of lines per inch is made to conform proportionately. While there was suggestion for the adoption of two standards so that they could be tested more thoroughly, the Commission believes that there should be a single standard, as in television, to enable all facsimile receivers to operate from all facsimile stations within range.

The rules provide for the use of both simplex and multiplex facsimile. Simplex is employed when an FM station is not transmitting aural programs and multiplex is the transmission of both simultaneously. The Commission holds that, while multiplex facsimile has not been fully developed, its importance requires current provision for it. FM broadcasters will hesitate to interrupt aural programs for the transmission of simplex facsimile and, therefore, multiplexing must be used for the fullest development and use of FM and "Fax" together. Recent experiments indicate that multiplexing can be accomplished without perceptible degradation of the aural program.

A band of frequencies has also been provided for experimental facsimile operation, in the 470-megacycle range, but no facsimile stations have as yet been proposed for these frequencies.

8. REMOTE PICK-UP BROADCAST SERVICE

Stations in this service are used to furnish temporary circuits to the main studio or transmitter of broadcast stations in connection with parades, sports events, and other programs picked up at points where wire circuits are not available or convenient. Since remote pick-up transmitters are often mounted in automobiles or light trucks, they are also useful for emergency communications when normal communication facilities are disrupted by floods or other disasters. The number of remote pick-up stations decreased from 583 to 571. This was because many applications for new stations were being held without action pending changes in frequency assignments. However, special temporary authorizations were issued during the year for operation of such equipment by some 200 stations.

9. ST (STUDIO-TRANSMITTER) BROADCAST SERVICE

The principal purpose of an ST broadcast station is to provide a program circuit between the studio of an FM station and its transmitter when the latter is located at a considerable distance or at an

inaccessible point, such as a mountain top. International broadcast stations may also employ ST stations for program circuits between studios and transmitters. Following the war, the band of 940 to 952 megacycles was allocated for ST broadcasting, and during the past fiscal year several manufacturers placed ST equipment on the market. ST transmitters are now being installed by a number of permittees and, in some instances, are replacing equipment temporarily employed on other frequencies. At the close of the fiscal year nine ST stations were authorized, compared to five the previous year, and inquiries indicated more in prospect.

10. DEVELOPMENTAL BROADCAST SERVICE

Developmental broadcast stations are employed chiefly for the testing of transmitters and antennas, for propagation studies, and for other experiments requiring radio transmission. Manufacturers test high-power FM transmitters and high-gain FM antennas for comparing actual performance with theoretical predictions. Activity in this service decreased during the year, and the number of stations declined from 24 to 15.

11. BROADCAST STATISTICS

AUTHORIZED STATIONS

The following table shows the number of stations (licensed or holding construction permits) in the various classes of broadcast service for the past 2 fiscal years:

Class of station	1947	1948	Increase
Standard (AM).....	1,795	2,034	239
Frequency modulation (FM).....	918	1,020	102
Television (TV).....	66	109	43
Television (experimental).....	81	124	43
Noncommercial educational.....	38	46	8
International.....	37	37	0
Facsimile.....	3	2	(-1)
Remote pick-up.....	583	571	(-12)
Studio transmitter (ST).....	5	9	4
Developmental.....	24	15	(-9)
Class 2 (experimental).....	1	0	(-1)
Total.....	3,551	3,967	416

In addition to the fixed stations enumerated above, 755 auxiliary mobile units were being utilized by the broadcast services as of January 1, 1948. The greater number—644—were engaged in remote pick-up; 76 were used in experimental television, 32 in developmental pursuits, and 3 in studio transmitter activities.

BROADCAST AUTHORIZATIONS BY STATES

Shortly after the close of the fiscal year a tabulation of 3,186 outstanding AM, FM, and TV broadcast authorizations collectively showed that Texas had the most of any State, closely followed by

California. Each had more than 200. Seven other States had 100 or more apiece.

Three States each held more than 100 grants in the AM field alone—Texas, California, and Pennsylvania ranking in that order. Puerto Rico had more AM authorizations than 16 States individually.

California led in FM authorizations, with New York and Pennsylvania tied for second place, followed in turn by Texas and Ohio. New Jersey, Ohio, and the District of Columbia held more FM than AM grants. Only one State—Montana—had no FM authorization.

The television listing saw California and New York tied for first place, with Ohio a close runner-up. Fifteen States were still without TV grants.

The break-down by States follows:

State	AM	FM ¹	TV	Total
Alabama.....	56	17	3	76
Arizona.....	25	2	1	28
Arkansas.....	28	7	0	35
California.....	130	86	12	228
Colorado.....	34	4	0	38
Connecticut.....	25	20	1	46
Delaware.....	5	4	1	10
District of Columbia.....	7	10	4	21
Florida.....	69	28	3	100
Georgia.....	70	31	3	104
Idaho.....	21	7	0	28
Illinois.....	66	50	5	121
Indiana.....	41	33	3	77
Iowa.....	45	22	2	69
Kansas.....	31	10	0	41
Kentucky.....	38	14	2	54
Louisiana.....	37	19	3	59
Maine.....	15	5	0	20
Maryland.....	22	15	3	40
Massachusetts.....	42	35	3	80
Michigan.....	59	36	3	98
Minnesota.....	38	11	3	52
Mississippi.....	35	7	0	42
Missouri.....	40	24	2	66
Montana.....	26	0	0	26
Nebraska.....	18	6	2	26
Nevada.....	12	3	0	15
New Hampshire.....	11	7	0	18
New Jersey.....	19	21	1	41
New Mexico.....	20	1	1	22
New York.....	91	76	12	179
North Carolina.....	86	44	2	132
North Dakota.....	15	2	0	17
Ohio.....	56	65	11	132
Oklahoma.....	39	15	2	56
Oregon.....	37	12	1	50
Pennsylvania.....	102	76	7	185
Rhode Island.....	8	7	1	16
South Carolina.....	37	14	0	51
South Dakota.....	15	1	0	16
Tennessee.....	54	26	1	81
Texas.....	164	69	6	239
Utah.....	18	3	1	22
Vermont.....	7	0	0	7
Virginia.....	40	28	1	78
Washington.....	45	8	1	54
West Virginia.....	33	18	0	51
Wisconsin.....	50	29	1	80
Wyoming.....	12	1	0	13
Alaska.....	8	0	0	8
Hawaii.....	9	0	0	9
Puerto Rico.....	25	4	0	29
Virgin Islands.....	0	0	0	0
Totals.....	2,045	1,033	108	3,186

¹ Does not include noncommercial educational broadcast stations.

BROADCAST APPLICATIONS
AM BROADCAST APPLICATIONS

	Pending July 1, 1947	Received	Disposed of	Pending June 30, 1948
Construction permits:				
New stations.....	666	385	476	575
Change in facilities.....	254	320	268	306
Total construction permits.....	920	705	744	881
Licenses.....	113	701	620	194
Renewals.....	152	616	571	197
Transfers.....	58	271	247	82
Modification of construction permits.....	90	263	246	107
All other.....	159	1,477	1,538	98
Total AM applications.....	1,492	4,033	3,966	1,659

FM BROADCAST APPLICATIONS

Construction permits:				
New stations.....	431	167	410	188
Change in facilities.....	11	14	20	6
Total construction permits.....	442	181	430	193
Licenses.....	16	172	107	81
Renewals.....	9	54	46	17
Transfers.....	12	95	80	27
Modification of construction permits.....	102	373	395	80
All other.....	1	1,468	1,398	71
Total FM applications.....	582	2,343	2,456	469

¹ Includes 106 conditional grants.

TV BROADCAST APPLICATIONS

Construction permits:				
New stations.....	10	353	69	294
Change in facilities.....	0	27	8	19
Total construction permits.....	10	380	77	313
Licenses.....	0	3	2	1
Renewals.....	0	7	7	0
Transfers.....	0	11	11	0
Modification of construction permits.....	7	64	71	0
All other.....	1	114	105	10
Total TV applications.....	18	579	273	324

ALL OTHER BROADCAST APPLICATIONS

Construction permits:				
New stations.....	39	205	131	113
Change in facilities.....	2	27	17	12
Total construction permits.....	41	232	148	125
Licenses.....	6	102	83	25
Renewals.....	59	221	238	42
Transfers.....	0	48	46	2
Modification of construction permits.....	10	22	31	1
All other.....	1	120	113	8
Total all other applications.....	117	745	659	203

TOTAL BROADCAST APPLICATIONS

Construction permits:				
New stations.....	1,146	1,110	1,086	1,170
Change in facilities.....	267	388	313	342
Total construction permits.....	1,413	1,498	1,399	1,512
Licenses.....	135	978	812	301
Renewals.....	220	898	862	256
Transfers.....	70	425	384	111
Modification of construction permits.....	209	722	743	188
All other.....	162	3,179	3,154	187
Total applications.....	2,209	7,700	7,354	2,555

CHAPTER IV. SAFETY AND SPECIAL RADIO SERVICES

1. GENERAL
 2. AERONAUTICAL RADIO SERVICES
 3. MARINE RADIO SERVICES
 4. EMERGENCY RADIO SERVICES
 5. RAILROAD RADIO SERVICE
 6. UTILITY RADIO SERVICE
 7. INDUSTRIAL, SCIENTIFIC, AND MEDICAL RADIO SERVICE
 8. MISCELLANEOUS RADIO SERVICES
 9. EXPERIMENTAL RADIO SERVICES
 10. LOW-POWER RADIO SERVICES
 11. PROPOSED LAND TRANSPORTATION RADIO SERVICES
 12. PROPOSED INDUSTRIAL RADIO SERVICES
 13. SAFETY AND SPECIAL SERVICES STATISTICS
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1. GENERAL

Because broadcasting commands so much attention from industry and the individual listener, it is not realized generally that the expanded use of radio is being felt more in the nonbroadcast services. For administrative purposes, the latter are grouped as safety and special services or common-carrier services, as they may require. This chapter deals with the safety and special services. As their general classification implies, they are devoted largely to the safeguarding of life and property, at the same time contributing to economies and improvements in public and private business operations. Some common-carrier communications functions have been included for convenience because they are inextricably related to safety functions, e. g., aeronautical public-service stations, various marine radio services, certain special emergency radio services, etc. The amateur and citizens services are dealt with in a separate chapter.

A myriad of specialized services are offered by stations in the safety and special services. Most of them function in connection with air, sea, and land transportation, and police, fire, and other public protection. Still others are concerned with developing new equipment and techniques suitable for public or private uses.

Such activities are in keeping with provisions of the Communications Act which, among other things, charges the Commission with "promoting the safety of life and property through the use of wire and radio communication," and requires it to "study new uses for radio, provide for experimental use of frequencies, and generally encourage the larger and more effective use of radio in the public interest."

A gain of nearly 11,000 authorizations was noted in the safety and special services last year, bringing the total to almost 47,500. Of the latter figure, nearly 21,000 were accounted for by the aeronautical services, and slightly over 15,000 by the marine services. However, there were marked and proportionate increases in the public safety and land transportation services.

Applications received by the safety and special services (exclusive of amateur) approximated 57,000 for the year, or some 4,000 more than in 1947. They covered the use of radio from the cradle to the grave, since requests ranged from a radio system for a pick-up-and-delivery baby diaper wash to radio control for funeral corteges at a large cemetery.

Most of the nonbroadcast services were in a state of flux, due to changes made necessary by developments in equipment and techniques and revision of world radio agreements. Establishment of new services increases the problem of finding frequency space and regulating operation. As each new use of radio emerges from the experimental stage, procedures must be inaugurated to handle the newcomer in the light of international as well as domestic considerations.

Of prime interest during the year was Commission proposal to establish two new general groups—land transportation and industrial—which would embrace various new or present radio services.

2. AERONAUTICAL RADIO SERVICES

The aeronautical radio services constitute one of the most important groups in the safety category. Radio has become invaluable in the operation of aircraft under all conditions and is used in many ways for operational purposes and to protect life and property in general. Aviation radio involves navigational aids, including fixed beacons, ranges, radar devices, direction-finding systems, etc.; traffic control operations; approach and blind-landing systems; special devices such as radio altimeters and distance measuring equipment; and public correspondence systems.

The year witnessed a continued expansion in civil-aviation activities. With the exception of the amateur service and commercial operators, the aeronautical services now constitute the largest single group licensed by the Commission. There were 20,858 authorized aircraft and ground stations at the close of fiscal 1948 as compared to 15,943 for the year previous. Applications received during the 1948 fiscal year totaled 22,324.

AVIATION ORGANIZATIONS AND CONFERENCES

Developments in this field brought many new problems and required increasing attention by the organizations which coordinate national

and international aviation activities. The three leading groups of this character are the International Civil Aviation Organization, the Radio Technical Commission for Aeronautics, and the Air Coordinating Committee.

The International Civil Aviation Organization (ICAO) is an international organization which works toward the development of principles and techniques in air navigation and fosters the planning and development of international civil aviation throughout the world. Activities in the ICAO have centered on those phases of aviation dealing with communications, and have included, during fiscal year 1948, the preparation for and participation in three ICAO Regional Air Navigation meetings, namely, South Atlantic, European-Mediterranean, and North Atlantic; and one ICAO Divisional meeting at Montreal which concerned personnel licensing. Representation at these meetings insures that the established policies of the Commission will be reflected in the deliberations wherever applicable, and further insures that the Commission will be kept informed on current trends in international aviation telecommunications requirements which, because of the nature of aviation operations, affect and, in many instances become a part of, domestic requirements.

The Radio Technical Commission for Aeronautics (RTCA) is a cooperative association of United States Government-industry aeronautical telecommunications agencies. It conducts studies of aeronautical telecommunications problems and related matters, and its objective is the resolution of such problems by mutual agreement of its member agencies. Its findings are in the nature of recommendations to all domestic organizations concerned. One of the major and continuing activities of the FCC's Aviation Division involves participation in the Executive Committee and special technical committees of the RTCA. During the last year these activities have included studies such as:

1. Formulation of principles for a national system of all-weather air-traffic control and the development of recommendations regarding equipment and procedures required to implement these principles.
2. Image interference from FM stations to VHF localizers associated with instrument-landing systems.
3. Harmonic emissions from television stations which affect aviation radio in the 108- to 132-megacycle band.
4. Revision of United States policy for air navigation and traffic control.
5. Testing program for long-range aviation-navigation facilities.
6. Standardization of distance-measuring equipment (DME) and testing procedures.
7. Implementation of air-traffic control transponder "private line" visual communications equipment.

8. Implementation of VHF emergency and airway-station communication frequencies.

9. Power output of VHF air-borne transmitters.

Another continuing activity involves participation in the work of the Air Coordinating Committee (ACC), its divisions and subcommittees. The ACC was established for the purpose of reaching decisions which would become the position of the United States in aviation matters. The Commission has representation on the Technical Division of ACC and the following subcommittees: Aeronautical Communications and Electronic Aids; Airspace, Rules of the Air, and Air Traffic Control; Search and Rescue; Dimensional Standardization; and Airmen Qualifications.

Another committee was recently established by the ACC, entitled Air Traffic Control and Navigation Panel (NAV Panel) for the purpose of guiding the implementation of the national all-weather air-navigation and traffic-control system recommended by the RTCA.

An International Aeronautical Administrative Radio Conference, called by the Administrative Council of the International Telecommunications Union, was held beginning May 15, 1948, at Geneva. This conference had for its purpose the preparation of a world-wide plan of assignment of mobile frequencies in bands allocated exclusively to the aeronautical service. Prior to this conference the Department of State convened a preparatory committee composed of representatives from the Army, Navy, Air Force, Commerce, Treasury, FCC, the various air lines and Aeronautical Radio, Inc., to do the necessary preparatory work of outlining the United States position, performing the detailed engineering, and preparing documentation to support it, and providing the instructions to the American delegation. The Aviation Division actively participated in the preparatory work and two of its members were on the delegation to the conference. The Chief of the Aviation Division was vice chairman of the delegation, and was the United States spokesman at the conference, since the chairman of the delegation was elected conference chairman.

AIRCRAFT RADIO

As in past years, the largest increase in the aeronautical radio services was that of private aircraft. There were 17,736 authorized aircraft radio stations at the close of the fiscal year as compared with 14,627 in 1947, and of the former nearly 16,000 were private aircraft.

The growth of air traffic and associated radio aids created a need for a national system of all-weather air traffic control. A study of this matter was made through the medium of the RTCA, in which all interested Government agencies and private interests were represented. It resulted in the formulation of principles and the develop-

ment of recommendations regarding equipment and procedures required to implement these principles. The over-all acceptance by aviation interests of this 15-year program of development and implementation of an all-weather system of traffic control points towards the largest increase in aviation radio activities in history.

The current effects of this program, as well as the pressing needs of aviation for specialized radio equipment, is indicated by the increase in the number of aircraft installing radio altimeters, terrain clearance indicators, and distance measuring equipment. They create new problems for the Aviation Division as far as licensing procedures are concerned, so the first applications of this nature must be especially treated until new policies or rules are formulated.

AERONAUTICAL LAND AND AERONAUTICAL FIXED RADIO STATIONS

These stations provide the radio communication service necessary for the safe, expeditious, and economical operation of aircraft. Domestic air carriers are required to maintain two-way ground-to-air radiotelephone communication at terminals and at such points as may be deemed necessary by the Government to insure satisfactory communications over the entire route. Such systems shall be independent of radio facilities provided by Federal or other governmental agencies.

The revival of the Civil Air Patrol, as a civilian auxiliary of the United States Air Force, has caused a large increase in the number of aeronautical and aeronautical fixed stations authorized for its communications network throughout the Nation. It is the ultimate aim of the organization to so connect the 48 States and the District of Columbia together for national emergency or local disaster purposes. Approximately 1,000 such stations are now operated by the Civil Air Patrol.

There were 2,761 aeronautical and aeronautical fixed stations at the close of fiscal 1948 compared to 1,435 in fiscal 1947. This increase is due to the extension of air-line routes, the expanded use of very high frequencies, and the growth of the Civil Air Patrol. The Commission adopted a very high-frequency allocation plan on October 25, 1946, and many aeronautical stations utilizing VHF to supplement their high-frequency service were authorized during the year.

AIRDROME CONTROL STATIONS

The number of airdrome control stations licensed at the end of the fiscal year was 59, an increase of 1 since 1947. Airdrome control stations for the most part are operated by the Civil Aeronautics Administration. While there has been a great increase in the number of airports and airdrome control stations, the majority of these were inaugurated and operated by the CAA. Further implementation of

the very high frequencies has caused considerable modifications of licenses for existing airdrome control stations.

AERONAUTICAL MOBILE UTILITY STATIONS

This service was first implemented in February 1947, and at the end of fiscal year 1947, 18 stations were licensed. As of June 30, 1948, the Commission had on license 109 such stations. They are used aboard crash, maintenance, emergency vehicles, etc., at airdromes for communicating with control towers, ground vehicles, and aircraft on the ground. This service is used by many municipalities and individuals concerned with the care and upkeep of airports.

AERONAUTICAL NAVIGATION RADIO STATIONS

Aeronautical navigation radio stations are for the most part operated by the Federal Government. However, as the combined civil-military system of air navigation and air traffic control becomes implemented, those licensed by the Commission will increase sharply. Furthermore, the RTCA program has recommended the installation of a considerable number of radar and radio facilities, in addition to a large expansion in the number of present radio facilities. The Commission had authorized 66 such stations at the close of the year 1948 as compared with 19 stations in 1947.

FLYING SCHOOL RADIO STATIONS

A flying-school station is a station on the ground or on board aircraft used for communications pertaining to instructions to students or pilots while actually operating aircraft. There were 23 of these stations in 1948, or 8 more than the year before. This increase is largely the result of flight-training instructions under the GI bill of rights, and it is expected that this service will continue to increase.

FLIGHT TEST RADIO STATIONS

A flight test station is a radio station, ground or aircraft, used for the transmission of communications in connection with the test of aircraft or major components of aircraft. The steady increase in development of new types of planes for civil and military aviation has caused a marked increase in the number of flight test radio stations. At the close of the year, there were 104 flight test stations in comparison with 82 in 1947.

AERONAUTICAL PUBLIC SERVICE STATIONS

The public service type of station has been provided to enable individuals aboard aircraft in flight to communicate with certain land radio facilities connected with land-line telephone or telegraph systems. The frequencies available to ship telegraph and ship telephone stations are available to aeronautical public service aircraft stations for the

handling of public correspondence in the same manner and to the same extent that they are available to ships of the United States. Although an adequate public air-ground telephone communication system has not been provided for complete coverage of the United States, the service, when established in its final form, should enable the user to select at will any subscriber to the national network.

Public service aircraft radio stations have been authorized aboard private aircraft, domestic air carriers and transport planes engaged in overseas flights. Tests are being conducted to determine the feasibility of utilizing two-way telephone service on overseas flights. At the present time air carriers engaged in overseas flights use certain telegraph facilities for the handling of public correspondence. This operation provides for air-to-ground telegraph service only. This service increased steadily and the year closed with 512 authorizations.

AIRCRAFT RADIOTELEPHONE OPERATOR AUTHORIZATIONS

These are special authorizations for operators of radiotelephone installations on private aircraft and are treated under Radio Operators. (See ch. VI.)

3. MARINE RADIO SERVICES

GENERAL

The maritime mobile service which concerns the use of radio for marine safety, navigation, and commerce is in a period of intense activity and development. Since marine radio activity is largely international in scope, the Commission has considerable continuing responsibility in helping prepare for and participating in the involved international conferences and in implementing the resultant treaties and conventions by appropriate regulatory action.

The revised Convention for Safety of Life as Sea, London, 1948, to become effective January 1, 1951, is a marked advance in safety over the 1929 convention. Improved measures include better coverage of the 500 kilocycle distress frequency, additional radio requirements for cargo vessels of between 500 and 1,600 gross tons, the requirement for at least 2 qualified operators on a designated class of passenger vessel, stipulation of technical details for new types of auto-alarms, extension of direction-finding apparatus to all ships over 1,600 gross tons, provision of detailed technical conditions for lifeboat radio apparatus, and increased recognition of the value of radar and other electronic aids. Commissioner E. M. Webster served as chairman of the Radio Committee of the conference.

From the point of view of the maritime service, the most important accomplishments of the 1947 Atlantic City Conference were the designation of a world-wide distress frequency for ship radiotelephone

stations, a long-distance calling frequency for survival craft at sea, a very high (short-distance) frequency for world-wide ship-to-ship and ship-shore communication, and specific bands of frequencies for ship borne radar. The frequency band used for loran stations was recognized tentatively and frequencies were allocated for the maritime telegraph and telephone services. While the international marine service, in common with other radio services, did not receive all of the spectrum space it requires, the best compromise attainable was reached and, with appropriate administration by each country, the number of channels should be reasonably satisfactory.

To implement provisions of the new radiocommunication regulations, many of which will become effective January 1, 1949, the Commission must make comprehensive revisions of its rules and regulations governing the ship and coastal services. Other provisions will not become operative until a new international frequency list has been approved by a future conference. Included on the list will be new frequency assignments for all United States coastal stations licensed in the international service.

Radiotelegraphy continues to meet the needs of the large ocean-going vessels and transport aircraft. In most instances, the radiotelegraph installation on vessels for safety purposes is used also for commercial service. Supplementing the shore radio stations of the United States Coast Guard, which do not engage in commercial communication, the numerous public service coast telegraph stations render a safety service in addition to exchanging commercial message traffic with ships and aircraft.

Besides being used on most large transoceanic passenger vessels, radiotelephony has come to be regarded as a necessity by ocean fishing fleets, many coastwise cargo ships, and practically all classes of vessels navigating the inland waters. In addition, numerous aircraft now obtain radiotelephone connection with land-wire systems through the maritime coastal stations.

The need for additional radio frequencies to carry maritime radiotelephone communications without intolerable interference between stations is one of the current major regulatory problems. The Commission is studying the possibility of improving and expanding the maritime telephone frequency allocations through the medium of formal reallocation proceedings and the preparation of technical recommendations for the Fourth Inter-American Telecommunications Conference.

Radio direction-finding apparatus continues to serve as a time-tested aid to navigation in coastal waters and on the Great Lakes, and as a means of locating radio-equipped lifeboats at sea. More recently developed marine radio aids—mainly radar and loran—are meeting

wide acceptance. Since radar requires radio transmitting apparatus, it is necessary for radar installations to be licensed by the Commission. Several hundred such licenses already have been granted. The principal regulatory control over ship radar stations is administered through engineering coordination with radar manufacturers.

Interest is being shown by port authorities and shipping organizations in securing authority to operate radar stations on shore to supply information regarding the exact locations of ships in harbors, especially during periods of restricted visibility. The Commission, in consultation with the Coast Guard and other interested Federal agencies, is studying an appropriate regulatory policy.

SAFETY AT SEA

The radio provisions of the 1929 Safety at Sea Convention, the ship radio requirements of the Communications Act, and the provisions of the Ship Act of 1912 applicable to the Great Lakes continued to be administered by the Commission. Important elements in the requirements for ocean-going vessels are the radio operator and his hours of watch, the radiocommunication equipment, the direction-finding apparatus, and the automatic distress alarm receiver (autoalarm).

As of June 1, 1948, the Commission's records showed that 2,402 ships of United States registry are subject to part II of title III of the Communications Act (compulsory radiotelegraph equipment and operators for voyages in the open sea, either domestic or international). Practically all United States ships subject to the radiotelegraph requirements of both the present and the new Safety Convention (international voyages) are included in this group inasmuch as the United States requirements generally are more stringent than the international radio provisions. Hence, the new convention will have practically no effect on the number and class of United States cargo ships over 1,600 gross tons and the number and class of United States passenger ships that are subject to compulsory radiotelegraph requirements and Government radio inspection.

The new convention, however, provides for compulsory radiotelephone equipment and operators on cargo vessels between 500 and 1,600 gross tons engaged on international voyages, unless exempted by the administration having jurisdiction. It is estimated that there are approximately 187 ships of United States registry to which this new requirement would apply after December 31, 1950.

While radiotelephony, in comparison to radiotelegraphy as a marine safety communication system, was not proposed nor strongly favored at London by the United States delegation, it was accepted as a progressive measure even though telephony for safety purposes at sea

has not, as yet, reached a state of efficiency satisfactory to the Commission. With the future placement in effect of the new world-wide 2,182 kilocycle telephone distress frequency adopted at Atlantic City, the value of telephony for ship safety should materially increase.

Not more than one qualified radiotelegraph operator need be carried on any ship under provisions of the 1929 convention. The 1948 convention requires at least 2 such operators on every passenger ship engaged on an international voyage exceeding 16 hours' duration between 2 consecutive ports and carrying or certified to carry more than 250 passengers.

The 1929 convention does not require an auto-alarm on any ship under 3,000 gross tons nor on a cargo ship of between 3,000 and 5,500 gross tons if on the latter an operator watch of at least 8 hours per day is maintained. This deficiency is overcome by provisions of the 1948 convention wherein all ships subject to that convention (except cargo vessels of less than 1,600 gross tons) must have continuously available a means for intercepting distress signals by either auto-alarm or listening by human operator.

The 1948 convention details technical conditions which must be met by new types of auto-alarms after January 1, 1951. However, existing approved types may continue to be installed and used for an indefinite period. There have been no basic improvements in auto-alarms since the original type approval was given by the Commission in 1937.

The Communications Act and the 1929 convention require the carrying of radio direction finders only on passenger vessels of 5,000 gross tons and above. The 1948 convention extends this requirement to all ships of 1,600 gross tonnage and upwards when engaged on international voyages. Cargo ships of the United States equipped voluntarily with direction finders number 2,244. Many of these will be subject to the new international requirement. Although direction finders are used mostly for routine navigation, they are indispensable for locating distressed vessels or survival craft at sea from which radio emissions are being sent.

With respect to radiotelegraph installation on motor lifeboats, conditions to be met are set forth in the 1948 convention in regard to the radio cabin, prevention of interference from the engine, charging of the radio battery, frequencies, class of emission, ability to receive as well as transmit, use of automatic-alarm keying device, type of antenna, and the conduct of periodic tests and inspections. Ships carrying less than 20 lifeboats must be provided with an approved portable radiotelegraph apparatus capable of placement, in the event of emergency, in any available lifeboat. The lifeboat radio requirements for receiving equipment, for the operation of the transmitter on a high frequency in addition to 500 kilocycles, and for an automatic-alarm keying device.

are of special safety value and represent a distinct advance in facilitating rescue at sea.

In recognition of the problems of procurement and design regarding new equipment with which the marine radio industry and the ship-owners will be confronted, appropriate "delay clauses" are incorporated in the 1948 convention with respect to those items of equipment which may not be readily available prior to the effective date of the revised convention and regulations.

The 1948 convention liberalizes the conditions under which exemption or relaxation from normal radio requirements may be granted in behalf of individual ships. These changes should have little, if any, effect on the established policy of the Commission which never has favored general relief from ship radio requirements. During the year, however, 38 of 44 applications for exemption were granted by the Commission, mostly for small passenger vessels of less than 100 gross tons. A few grants were approved for larger vessels because of the temporary unavailability of equipment or other unusual circumstances.

SAFETY ON THE GREAT LAKES

Regulations annexed to the 1948 convention state that "nothing herein shall apply to ships solely navigating the Great Lakes of North America and their connecting and tributary waters as far east as the lower exit of the Lachine Canal at Montreal in the Province of Quebec, Canada." Only the Ship Act of 1912 now applies to certain large passenger steamers navigated in those waters. The Commission made a special report (dated December 16, 1940) to the Congress concerning radio requirements for ships navigating the Great Lakes (S. Doc. 318, 76th Cong., 3d sess.). Preparatory work looking to a treaty between Canada and the United States on this subject was commenced by a United States Government group in the fall of 1941. This work, interrupted by World War II, was further suspended until the conclusion of the 1948 conference. In the meantime, the voluntary use of radiotelephony and radio direction finders, including the more recent use of ship-borne radar, is widespread on the Great Lakes and provides a considerable safeguard.

COMMERCIAL COMMUNICATION

With respect to ship and coast stations and aircraft stations communicating with these stations, the Commission enforces the international general radiocommunications regulations. They were adopted by the Cairo conference in 1938. The superseding regulations, adopted at Atlantic City, reflect two highly significant changes. One of these will allow aircraft to use designated high frequencies of the maritime radiotelegraph service for public correspondence. The second of

these changes includes a plurality of calling frequencies, specific channeling, and complete harmonic relationship of ship telegraph frequencies throughout the HF spectrum. Of special importance is the comparative freedom from interference which will be afforded large passenger vessels and provision for the use of adjuncts such as teleprinter and facsimile.

In further recognition of long-distance ship-shore public telephone service in connection with land-wire systems, nine series of radiotelephone communication "channels" (two high frequencies per channel) were designated by the conference for use by ships and coastal stations on a world-wide basis.

It was generally agreed that the success of the world plan depends on the orderly distribution of the world's ship stations throughout the designated frequency bands. The Commission, accordingly, is confronted with a license modification proceeding of substantial scope which will need to be coordinated with the shipping industry, radio manufacturers and installers, and interested Federal agencies.

Two new public coastal telegraph stations were authorized, one at Beaumont, Tex., and the other at Norfolk, Va. The Commission, in cooperation with the Interdepartment Radio Advisory Committee, endeavors to provide satisfactory frequency assignments for each new coastal telegraph station. This is a difficult problem, however, in view of the decrease in spectrum space assignable to this class of station which has resulted from the new frequency allocations table adopted at Atlantic City.

The city of Baltimore, Md., was authorized to establish a new land radiotelephone station relative to the operation of ice breakers and handling occasional emergencies involving shipping in the harbor and upper Chesapeake Bay. To facilitate operation of State-owned ferry boats plying across the Chesapeake Bay between Sandy Point and Matapeake, the State of Maryland was licensed to use radiotelephone stations at those shore points and on board the ferries.

The trend toward telephony was exemplified further by the establishment of additional public service radiotelephone shore stations at Jacksonville, Fla., and Hilo, Hawaii, by petitions from two public service licensees requesting permission to discontinue operation of their Great Lakes radiotelegraph shore stations and by proposals from others to establish new land radiotelephone stations at Chicago and Milwaukee. At Kahuku, Hawaii, additional facilities were installed to improve long-distance public telephone service to vessels navigating trans-Pacific routes.

Approximately 11,000 ship stations are now licensed by the Commission for radiotelephony. In addition to ship-shore service, there is a very large amount of ship-to-ship telephone communication. The

two frequencies normally available for this service are inadequate to carry this message traffic. Further, some 300,000 additional vessels of United States documentation must be considered as potential users of radiotelephony. Hope exists for accommodating all present and future users of this service through the accelerated development and practical application of very high frequencies. The use of such frequencies should provide a better short-distance service and allow the more conventional frequencies (below 3,000 kilocycles) to be used mainly for communication over longer distances. Developments in this field are mostly contingent upon the outcome of hearings conducted by the Commission and agreements to be reached at the next Inter-American Radio Conference. Meanwhile, the Commission has permitted experimental marine radiotelephone operation on certain designated very high frequencies.

In Alaska, where both radiotelegraphy and radiotelephony are widely used to exchange safety, weather and commercial messages, the number of licensed land stations increased to 412 for point-to-point communication and 277 for communication with ships. These stations normally are licensed for general public correspondence and operate in conjunction with the network of Government stations under jurisdiction of the Army Signal Corps.

After approximately 4 years of development work, a ship "call alarm" is in use on board some vessels in connection with commercial service. This device reportedly will respond to the radio call letters of the ship when they are transmitted in Morse radiotelegraph characters from a coast or ship station, whether or not a radio operator is actually on duty on the receiving ship.

RADIO NAVIGATIONAL AIDS

Supplementing the long-used radio direction finder (radio compass), two other navigational aids utilizing radio, namely, radar and loran, are now generally accepted in the United States as valuable additions to the mariner's equipment. The 1948 conference recognized radar's wide applicability for anticollision, pilotage, above-water obstacle detection, and general position fixing. The conference recommended that Governments encourage the development, manufacture, and installation of ship-borne radar, and the training of personnel in its use. At the same time, however, the opinion was expressed that the possession of radar in no way relieves the master of a ship from his obligations under the international regulations for preventing collisions at sea. There were instances during the year in which vessels collided with one another, even though one or both vessels were equipped with radar.

More than 600 ship radar stations are now licensed. Effective De-

ember 10, 1947, the Commission adopted rules transferring the licensing of shipboard radar from the experimental to the established ship service. On January 1, 1949, the frequency bands authorized for these stations will be recognized by world-wide international agreement.

An important issue yet to be decided by the Commission is whether or not persons making technical adjustments to radar transmitters should be licensed. The users of radar, normally deck officers, are not required to hold operators' licenses. Pending a determination of this issue, technicians who make or supervise important adjustments are required to hold a radio operator license.

Present rules applicable to radar transmitting apparatus are directed primarily toward preventing harmful interference. Several types of ship radar equipment have been examined for conformance and, pending clarification of final technical requirements, were given tentative approval.

While radar will serve to fix the position of a ship within less than 50 miles of identifiable shore line, and the direction finder is useful to obtain a "fix" up to 200 miles from radio beacons afloat and ashore, loran can provide accurate long-distance offshore position-fixing by radio. Loran is especially valuable when weather conditions make celestial observation impossible, a condition not infrequent in the North Atlantic in winter. Loran is used by transoceanic aircraft as well as by surface ships, and is of particular value to offshore fishing fleets. It is dependent upon the continuous operation of numerous loran transmitting stations on shore. The operation of the latter is an international cooperative program in that Canada, Denmark, Iceland, United Kingdom, and the United States (Coast Guard) are jointly maintaining stations to serve wide sea areas of both the Atlantic and the Pacific. Although certain European countries look with favor upon other long-range marine radio navigational aids involving land transmitters, such as "consol" and "decca," loran for general purposes appears to provide the highest accuracy of any that have been used operationally to date. While the Commission does not license loran equipment, its use is definitely related to the allocation of marine frequencies.

4. EMERGENCY RADIO SERVICES

The emergency radio service provides radio communication essential to the public safety or the alleviation of an emergency endangering life or property. This service is available to States, counties, towns, and similar Government entities, also other bodies or individuals performing similar duties.

Rules governing the emergency service, in effect since 1938 with

minor modifications, have had to be rewritten completely and a final revision (pt. 10) was proposed June 11, 1948. Besides incorporating frequency allocations for each of the services covered, these rules contemplate a new service—the highway maintenance radio service—and the forestry radio service would be expanded into a forestry-conservation radio service.

Technical standards are also proposed. Their need is evidenced by the number of stations operating in these services. As of June 30, 1948, the Commission had authorized some 4,900 public safety stations of all types operating approximately 55,000 transmitter units. The contemplated standards establish, among other things, a required measurement procedure for transmitters, allowable limits for spurious or harmonic radiation and control procedure. Their adoption would bring about a better utilization of frequencies in the emergency services.

POLICE RADIO SERVICE

The police radio service embraces more than 4,000 municipal police, State police, zone police, and interzone police stations. Working in an integrated manner, these stations provide intercommunication between police fixed and mobile stations, including aircraft and ships. Even the foot patrolman is not without radio contact. Developments in printed circuit and subminiature tubes provide an extremely lightweight transmitter-receiver combination which may be carried as easily as a hearing aid set.

In addition, the various municipalities and States have been assigned frequencies for relatively long-range communication and, consequently, are continually expanding their communication networks to include entire States and adjoining States. Thus, Nation-wide police communication circuits are now available.

Generally, police radio stations use frequencies in the VHF part of the spectrum—between 30 and 300 megacycles. Transmitters operating in this range are generally limited by “line-of-sight” transmission. In order to extend coverage, it is necessary to elevate the antennas. Since it is generally not feasible to erect police antennas more than 300 feet high, some base stations are installed on mountain tops or other elevated places and are operated by remote control. This provides a large “talk-out” area. To permit a comparable range for “talk-back” from mobile units, the base station receiver is usually installed at the location of the base station transmitter. In many cases this is far from telephone lines, so the base station requires auxiliary radio circuits called “fixed control” and “fixed repeater” links. By means of such links, many State systems provide satisfactory radio coverage over large areas where it would not be possible to install manually operated stations. Most of these links are presently operating on frequencies

between 72 and 76 megacycles. It is expected that within a relatively few years these links can be moved into the microwave part of the spectrum which is admirably adapted for such operation.

FIRE RADIO SERVICE

The fire radio service provides radio communication in connection with public fire prevention and control. More and more of the larger municipalities have established separate facilities to furnish fire radio communication service previously provided by municipal police radio stations. This service is expected to increase under proposed rules, principally because of the extension of eligibility requirements to enable volunteer fire departments to qualify, and the general tendency of municipalities to separate their police and fire radio communication facilities. Eighty-five municipal fire stations were authorized by June 30, 1948.

Fire fighters require two distinct types of communication: namely, that between the headquarters and the fire apparatus and, secondly, between the fire chief and the individual fireman at the scene of the blaze. The first form of communication permits headquarters to maintain contact with all fire apparatus out on call. The second enables the chief in charge on the ground to control the activities of the firemen under his jurisdiction. The former involves a land station with elevated antenna and transmitters mounted on the various vehicles. "On-the-spot" communication is provided by light-weight and low-powered packsets carried or worn by firemen fighting a fire. In its proposed revision of the emergency service rules, the Commission has divided the fire service into three groups. One group is restricted to low-powered packsets, a second group is limited to mobile operation only, while the remaining group is not restricted.

The Commission has received inquiries from individuals and rural communities regarding the feasibility of setting up radio fire alarm calling and signalling systems. Such installations are intended particularly for rural areas where wire lines are not available or cannot be installed economically. The matter is under Commission study.

FORESTRY-CONSERVATION RADIO SERVICE

Under the Commission's present rules, forestry radio stations are operated by governmental agencies—usually States or counties—responsible for the protection of timber from fire. Individuals or private organizations owning or responsible for protecting large tracts of wood, are also eligible for forestry stations. There were more than 450 such stations.

At the request of many State conservation agencies, the Commission is proposing to expand the forestry service into a forestry-conservation radio service. This would make it possible for such radio

facilities to be used in game law enforcement, protection of forest from insects and disease, reforestation, flood and erosion control, and similar activities. It is recognized, however, that forest-fire control should take precedence over any other conservation work. Accordingly, a large number of frequencies allocated for forestry-conservation use are devoted to forest fire-fighting. Pending the adoption of the proposed new part 10, the Commission has authorized the operation of a number of forestry-conservation stations on an experimental basis.

HIGHWAY MAINTENANCE RADIO SERVICE

This is a new emergency service which the Commission is proposing to meet the needs of highway departments of the various States and counties for radio communication in connection with their maintenance and repair activities. Radio facilities would aid in clearing highways of snow, land slides, and other obstructions. These departments also require instantaneous communication with maintenance crews during periods of floods or other natural disasters. They estimate that by radio contact between office and work crews, large savings in the cost of maintenance can be realized or, to put it another way, considerably more maintenance can be carried on for the same expenditures. Pending the establishment of a regular service, the Commission has authorized 126 stations on an experimental basis.

SPECIAL EMERGENCY RADIO SERVICE

The special emergency class of station offers radio communication in emergencies affecting the general public—to bridge breaks in existing landwire systems, and to establish temporary circuits.

The majority of the nearly 100 stations in this category are licensed to communications common carriers. Various Red Cross chapters have established stations to provide communication during national emergencies. Also, a few individuals and companies operating in remote areas not served by wire lines use special emergency stations to obtain assistance in case of accident or sickness.

5. RAILROAD RADIO SERVICE

Since the railroad radio service was established in 1945, authorizations have been issued to over 40 different railroads. In addition to being used on the main lines for safety purposes, radio has been found invaluable in yard and terminal switching operations. Mobile units installed in supervisors' cars help to coordinate various railroad operations. Portable units are employed by work crews during the construction and maintenance of tracks, bridges, and other railroad property along the right-of-way.

The growth of this service has been retarded somewhat by the lack

of equipment rugged enough to withstand the jolts and jars to which it is subjected. Another obstacle is lack of satisfactory power supply. Batteries and axle- and motor-driven generators have been used separately and in combination, with varying degrees of success. Problems of securing qualified personnel, and integrating a radio system with established operating and signalling practice, are other factors which have contributed to the delay.

In spite of these difficulties, the more than 200 railroad radio stations authorized by the close of the year is nearly double the 1947 total. One railroad has installed an experimental microwave relay system to determine its effectiveness as compared with the conventional wire line circuits. Since suitable equipment is now available, there is increased interest in the benefits of radio to railroad operation.

6. UTILITY RADIO SERVICE

Pending establishment of a new industrial radio service, the present utility radio service provides radiocommunication for three general types of public utilities—power, transit, and petroleum pipe lines. The first named serves electric, gas, water, and steam utilities. The transit utility station is used by busses, streetcars, subways, and other scheduled passenger-transportation lines in urban areas. Petroleum pipe-line stations are utilized in cross-country distribution of crude petroleum, petroleum products, and natural gas.

Established in 1946, the utility radio service permits licensees to transmit messages relating not only to safety of life and property, but also those in connection with essential operations, such as dispatching of maintenance crews and trucks. As of June 1946, utilities were operating 600 special emergency transmitters. In the same period of 1947, there were 1,136 stations in the utility service, which number practically doubled in 1948. What is more, each station included from one to 700 auxiliary transmitters.

The most important use of radio by utilities is in the maintenance or restoration of electric, gas, or water service. Other uses include coordination of construction activities, cable-pulling and wire-stringing crews, and emergency communications between load dispatchers and source of supply (generating station, gas storage area, or water reservoir).

The electric, gas, and water utilities industries (both publicly and privately owned) jointly organized regional frequency coordinating committees to assist the Commission in assigning appropriate frequencies. Each committee is made up of utility licensees in the area who desire to participate, and is generally managed by a group of local communications engineers appointed by the member companies. These advisory committees have rendered valuable assistance through their

intimate knowledge of local conditions and requirements. Without delegating administrative authority to these groups, some degree of self-regulation is achieved in a complex field where alternative solutions would require a substantial increase in Commission personnel.

There has been a similar expansion in the use of radio by petroleum and natural gas pipe lines. Several companies operating pipe lines between the Texas-Louisiana area and the eastern seaboard and the North Central States are preparing to install interlocking chains of radio stations en route.

The transit utility radio service was established for the purpose of providing radio communication to facilitate the operation of vehicles used in furnishing a passenger-transportation service over fixed routes in metropolitan areas. Mobile transmitters are installed on street-cars, busses, supervisors' cars, and repair trucks. This radio adjunct has been found to be especially effective when, due to storm damage or collision, it is necessary to reroute traffic or call for parts needed to make emergency repairs. Nearly 80 stations had been authorized for operation in this service. Although presently included with other public utilities in part 17 of the rules, it is proposed to group this service with other transportation common carriers in the land transportation radio services.

7. INDUSTRIAL, SCIENTIFIC, AND MEDICAL RADIO SERVICE

One of the greatest obstacles in the path of the ever-growing uses of radio is that of interference. It has been determined that the haphazard operation of medical diathermy, industrial heating, and certain other miscellaneous types of radio-frequency equipment are among primary sources of interference. In adopting part 18 of the Rules and Regulations Relating to Industrial, Scientific, and Medical Service, the Commission has taken a necessary step to provide interference-free radio operation.

Medical diathermy equipment as defined by the Commission's rules includes any apparatus (other than low power intermittent surgical diathermy equipment) which generates radio-frequency energy for therapeutic purposes. Industrial heating equipment refers to radio-frequency apparatus used for heating operations in a manufacturing or production process. Miscellaneous equipment covers apparatus in which the action of the energy emitted is directly upon the work-load and does not involve the use of associated radio receiving equipment.

Part 18 stipulates frequencies on which such equipment may operate and defines the extent to which harmonic and spurious radiations must be suppressed in order that interference to authorized radio services will be minimized. Part 18 became effective June 30, 1947, insofar as applicable to diathermy and industrial heating equipment. However, a slight change in frequencies was necessitated by the At-

lantic City conferences. These changes were made effective March 16, 1948. On April 30, 1948, the rules became effective as to miscellaneous equipment.

It is estimated that approximately 100,000 medical diathermy machines and 5,000 industrial heaters were in operation before these rules became operative. Most of this equipment was not designed to operate within the rules. However, in order to provide for depreciation of such equipment, part 18 does not become effective, insofar as applicable to equipment manufactured before the effective date of the rules, until July 1, 1952, provided operation of such equipment does not cause interference. In the event that interference is caused, necessary remedial steps must be taken immediately. Since that portion of part 18 which applies to miscellaneous equipment was not finalized until April 30, 1948, such equipment manufactured prior to that date may be operated until April 30, 1953, also subject to the non-interference condition.

To obtain uniformity in the design of industrial, scientific, and medical equipment, particularly as concerns the operating characteristics, provisions are made in the rules for type approval of such equipment by the Commission's laboratory. Since effectuating part 18, the Commission has issued certificates of type approval for 22 different models of diathermy equipment manufactured by 17 different companies.

The fact that no industrial heating equipment has been submitted to the Commission for tests is probably due to the large size of these machines and difficulties encountered in shipping them. However, part 18 provides for certification of such machines by competent engineers, in lieu of certification by the Commission's laboratory.

Because the rules pertaining to the operation of miscellaneous equipment have been in effect a relatively short time, few requests for type approval have been received for equipment in this category. However, the Commission is conducting industry conferences in an effort to eliminate severe interference from a relatively new type of arc-welder employing radio-frequency energy which is used on nonferrous metals such as aluminum. These conferences have contributed to mutual understanding of the problems involved, and the formulation of practical solutions. One interchangeable letter neon sign has been type approved. It is expected that other miscellaneous devices, such as germicidal lamps, display signs, and spectrographs, may also be approved.

8. MISCELLANEOUS RADIO SERVICES

These services cover provisional, geological, motion picture, relay press, and mobile press radio stations. The first two named comprise the greater portion of licensees in this group.

Provisional stations are authorized to transmit messages relative to safety of life and property, or other matters of public necessity, in areas not served by other forms of communication. They are used extensively in oil and gas well-drilling operations and, in more limited numbers, by construction and logging companies, irrigation projects and large-scale farming operations.

If the proposed industrial radio services become fact, the miscellaneous radio services would be deleted as such, and the industries now licensed thereunder would be provided for in the new services, or elsewhere.

GEOLOGICAL RADIO SERVICE

This term applies to stations operating in connection with probing the earth's surface and underlying strata for new oil and mineral deposits. Practically all of the 104 licensed geological stations, which represent more than 500 mobile units, are licensed to oil and geophysical exploration companies. Using low power, these stations transmit signals and impulses to seismic recording instruments from various listening points located at distances up to 15 miles from the point where the explosive is detonated. They are also utilized for communication by crews at work in isolated areas and for special functions in connection with less common methods of geophysical investigation. In addition to land operation, many stations are used aboard ship in the Gulf of Mexico as an aid to the search for underwater oil-bearing formations along the Continental Shelf.

MOTION-PICTURE RADIO SERVICE

Stations in this class provide communication for film crews on location in places where other facilities are not available, and aid in protecting life and property in that connection. Being mobile, they are particularly advantageous for coordinating and directing "mob" and pastoral scenes, and coordinating the activities of various units engaged in the actual filming. Their number increased slightly during the year. Correspondence with the film industry indicates renewed interest now that improved equipment is available at moderate cost.

RELAY PRESS RADIO SERVICE

Newspapers and press associations use these stations to transmit messages from remote locations to the nearest telephone. A number of requests have been received for authority to install land stations at newspaper offices for maintaining contact with reporters and other staff members at the scene of a news event or traveling in the vicinity. To obtain more information concerning this type of service, the Commission has authorized a number of class 2 experimental (relay press) stations.

9. EXPERIMENTAL RADIO SERVICES

This category covers radio stations engaged in research and experimentation for the advancement of radio. To provide for all types of such endeavor, these services are broken down into three broad categories, namely class 1, class 2, and class 3 experimental stations. Class 1 stations are authorized primarily to persons qualified to conduct general or specific research. Class 2 stations are authorized to persons engaged in research and experimentation directed toward the development of a new or proposed radio service, or improving an established service. Class 3 stations may be authorized to citizens interested in conducting limited-time experimental programs in their own behalf.

Most class 1 experimental stations are presently operated by equipment manufacturers and research and development organizations. Their experimentation involves not only the development of new uses of radio and electronics but also betterment of existing equipment. For example, one particular need is for equipment to operate on adjacent channels so as to permit the operation of many more radio communication systems in any given area. Much effort is also being expended toward the improvement of existing equipment to diminish spurious and harmonic emissions, thereby reducing interference among various radio communication systems. Other projects call for evolving equipment for operation in the microwave regions to further point-to-point communication.

Among class 1 authorizations during the year was one to an Oklahoma concern for the development of an extremely accurate radiolocation system to be used for locating oil deposits off the Gulf Coast. Another was made to a New York firm for the development of a radio-paging system for doctors. The latter contemplates the use of small compact radio receivers so that a doctor can be "paged" by means of coded transmissions from a central location to contact his office. A Connecticut company received a grant looking to development of an electronic speedmeter, operating on radar principles, for determining the speed of automobiles along highways. This information could be used to improve the "degree of slope" on curves to reduce driving hazards—also to apprehend motorists exceeding speed limits.

As a result of radar and other surplus war electronics material being made available through the War Assets Administration to various training institutions—particularly those training veterans under the GI bill of rights—the Commission received numerous requests for permission to operate this equipment. Normally the Commission does not authorize active radio stations for training purposes because, in most instances, adequate training can be given with dummy apparatus. However, adequate radar instruction cannot as yet be obtained by such means and, accordingly, the Commission has authorized many schools and colleges to use radar for training purposes.

Numerous class 1 authorizations are issued to manufacturers and sales engineers for field intensity or coverage surveys in areas where radiocommunication systems are proposed. Results of such surveys provide valuable information for choosing the proper operating frequencies, power, emission, and locations for best performance.

Applications for class 2 experimental stations usually involve proposals for establishment of new services which are not provided for in the regular services.

In view of the limited type of experimentation permitted by class 3 stations, the Commission receives few requests for such operations. Most types of experimentation permitted under the class 3 experimental rules may also be conducted under the amateur or class 1 experimental rules.

10. LOW-POWER RADIO SERVICES

The Commission's low-power rules (secs. 15.1 to 15.4 of pt. 15, formerly secs. 2.101 to 2.104 of pt. 2) provide certain limitations for the intensity of radio-frequency energy which may be radiated without necessity for licensing by the Commission. The largest benefactors from these rules are the various organizations using carrier current systems such as power companies, telephone companies, and railroads.

Various schools and colleges throughout the country are installing intracampus carrier current broadcast systems and the Commission has received numerous inquiries from other institutions and private individuals regarding such systems. Because of this interest and because of the increasing number of regularly established radio services, unlicensed low-power operations are becoming a potential source of interference. Accordingly, the Commission is studying its low-power rules with the view of revising them to meet new conditions.

Inquiries have been received regarding the use of radio for controlling model aircraft. It is estimated that there are approximately 10,000 such enthusiasts in the United States. The Commission's rules provide for such operations in the amateur and the citizens services. However, most inquiries of this nature stem from those who have the operation of their models primarily in mind and the use of radio is merely an incidental matter. Thus, in most instances they do not wish to go through the process of learning radio fundamentals to obtain amateur station licenses. Equipment is not yet available for use in controlling model aircraft in the citizens service. However, the 27 megacycle diathermy band provides a present medium for such operations. The Commission also proposes to permit equipment such as garage-door-openers to operate in this band, as well as short distance radiocommunication systems not provided for in other parts of the rules.

11. PROPOSED LAND TRANSPORTATION RADIO SERVICES

The Commission proposes to establish a general category of land transportation radio services to cover radio's uses in promoting the safety and operating efficiency of public land transportation common carriers. Part 16 of the rules, now in effect, relates entirely to the railroad radio services. So the Commission's revision will provide for the inclusion of the transit utility radio service, an intercity bus radio service, an intercity truck radio service, and a taxicab radio service. The transit utility radio service is now licensed under part 17 of the rules, whereas authorizations for radio systems operating in conjunction with trucks, buses, and taxicabs are presently issued in the experimental service.

The new rules, if adopted, will govern the operation and licensing of radio stations used in connection with all transportation common carriers. It is felt that the grouping of these services will result in a more efficient use of available frequencies and simplify administration.

TAXICAB RADIO SERVICE

In 1946 the Commission formulated a temporary assignment plan for the 24 frequencies in the 152- to 162-megacycle band allocated to the general mobile service, and made two of these frequencies available to the taxicab industry on an experimental basis.

Radio permits an efficient method of cab dispatching, as the necessity of having the cab driver return to the office or callbox for new assignments is eliminated. This, of course, results in a saving in time and distance traveled. At the close of the fiscal year, authorizations had been issued for approximately 30,000 mobile units subject to control from base stations. It is estimated that the taxicab industry will have invested \$10,000,000 in radiocommunication equipment during the calendar year 1948.

The use of radio for dispatching taxicabs produced such outstanding results and these systems increased at such a phenomenal rate that serious problems were presented. The chief difficulty arose from the fact that only two frequencies were available, which necessitated the sharing of airtime by all companies participating in the experimental program.

The Commission now contemplates establishing the taxicab radio service on a regular basis, with eight frequencies, as a part of the land transportation radio services.

INTERCITY TRUCK AND BUS RADIO SERVICES

The intercity truck radio service and the intercity bus radio service have been proposed in order to provide a radiocommunication service for vehicles carrying passengers and freight over the highways on a

common-carrier basis. These systems, too, are presently being authorized on an experimental basis. One bus company is operating an extensive system between Chicago and Detroit and plans to extend the system so that eventually communication will be possible with busses on the major highways of the country.

12. PROPOSED INDUSTRIAL RADIO SERVICES

Postwar radio developments have spurred industry demand for two-way vehicular communications equipment and other short-range radio circuits. This has made it necessary to look to reducing the number of station and service classifications already established while simultaneously revising the eligibility requirements. A step in this direction is the proposed establishment of an industrial radio service, which would include four general groups as follows:

POWER RADIO SERVICE

This category would cover radio facilities for persons engaged in generating, transmitting, collecting, purifying, or distributing, by means of wire or pipe lines, electrical energy, artificial and natural gas, water or steam for use by the public, or by members of a cooperative organization. At present the radio needs of this group are met partially by power utility stations which share a number of frequencies in the utility radio service.

PETROLEUM RADIO SERVICE

This service would be open to persons engaged in searching for, producing, collecting, refining, or piping petroleum or petroleum products (including natural gas). Communications along pipe lines are now provided for in the utility radio service, and certain other limited petroleum-industry communications are covered in other parts of the rules. Coordinated industry-wide communications, however, are not now available. Accordingly, it is anticipated that the new service will provide communication for the petroleum industry on a Nation-wide basis.

FOREST PRODUCTS RADIO SERVICE

Although much of the responsibility for the protection of a large proportion of the timber in the United States rests with private organizations, a radio service for this particular purpose has been available only to instrumentalities of Government or their direct representatives. The creation of a new forest products radio service, using frequencies shared with the petroleum industry, would make radio available to persons engaged in tree farming, logging, and related activities for the purposes of forest protection, safety of life and property, and efficiency of operations in remote areas where other means of communication are not available.

SPECIAL INDUSTRIAL RADIO SERVICE

The fourth group would provide radiocommunication for commercial or industrial operations which are predominantly rural in nature, as, for example, persons engaged in farming, ranching, irrigation, mining, and construction activities; those engaged in commercial and industrial operations which involve an element of hazard to life and property; those engaged in industrial or commercial operations which react directly upon the public welfare or safety; and those maintenance and repair services involving public health or well-being; and, finally, for all commercial interests, irrespective of eligibility elsewhere under the proposed rules, certain low power radiocommunication systems.

13. SAFETY AND SPECIAL SERVICES STATISTICS

AUTHORIZATIONS

There was a net increase of nearly 11,000 authorizations in the safety and special radio services during the last fiscal year. As of June 30, 1948, the authorized station count was 47,414 as compared with 36,529 the year previous. These figures do not include amateurs, who are covered elsewhere in this report. Following is a comparison of safety and special service authorizations for the past 2 years.

Class of station	1947	1948	Increase
Aeronautical:			
Aircraft.....	14,627	17,736	3,109
Ground.....	1,316	3,122	1,806
Total.....	15,943	20,858	4,915
Marine:			
Ship.....	10,989	13,720	2,731
Coastal and marine relay.....	131	148	17
Alaskan coastal.....	232	277	45
Alaskan fixed public.....	403	412	9
Other.....	200	467	267
Total.....	11,955	15,024	3,069
Public safety:			
Police.....	3,742	4,137	395
Fire.....	55	85	30
Forestry.....	668	461	(-207)
Highway maintenance.....	28	126	98
Special emergency.....	127	94	(-33)
Total.....	4,620	4,903	283
Industrial:			
Utility.....	1,136	1,656	520
Petroleum.....	468	412	(-56)
Lumber.....	0	32	32
Other.....	183	755	572
Total.....	1,787	2,855	1,068
Land transportation:			
Railroad.....	117	204	87
Transit utility.....	50	77	27
Intercity busses and trucks.....	25	24	(-1)
Taxicab.....	1,500	2,817	1,317
Total.....	1,692	3,122	1,430
Experimental:			
Experimental.....	500	527	27
Citizens.....	12	48	36
Miscellaneous.....	20	77	57
Total.....	532	652	120
Grand total.....	36,529	47,414	10,915

It should be pointed out that many of the foregoing authorizations covered the use of mobile units. In consequence, nearly 135,000 mobile units were associated with nonbroadcast services as of January 1, 1948. A break-down follows:

Fixed public-----	¹ 94	Transit utility-----	796
Aeronautical-----	20,517	Power utility-----	10,210
Marine-----	13,180	Petroleum pipe line-----	340
Police-----	32,166	Industrial-----	374
Fire-----	1,283	Experimental-----	² 46,216
Forestry-----	4,757	Miscellaneous-----	³ 3,212
Special emergency-----	378		
Highway maintenance-----	345	Total-----	134,924
Railroad-----	1,056		

¹ Includes agriculture, point-to-point telephone and telegraph, and fixed public press.

² Includes common carrier.

³ Includes provisional, mobile press, geological, meteorological, relay press, motion picture, and radio sounding.

APPLICATIONS

The safety and special services received 57,350 applications (exclusive of amateur) during the year. This was an increase of 4,049 over the previous year. Of the year's applications, 35,454 were disposed of. A break-down comparison for fiscal 1947 and 1948 follows:

Class of station	1947	1948	Increase
Aeronautical:			
Aircraft-----	22,247	19,021	(-3,226)
Ground-----	2,283	3,303	1,020
Total-----	24,530	22,324	(-2,206)
Marine:			
Ship-----	14,067	14,183	116
Coastal and marine relay-----	284	154	(-130)
Alaskan coastal-----	408	492	84
Alaskan fixed public-----	586	684	98
Other-----	250	812	562
Total-----	15,595	16,325	730
Public safety:			
Police-----	4,083	5,911	1,828
Fire-----	129	182	53
Forestry-----	451	727	276
Highway maintenance-----	25	147	122
Special emergency-----	456	58	(-398)
Total-----	5,144	7,025	1,881
Industrial:			
Utility-----	1,690	2,389	699
Petroleum-----	1,129	394	(-735)
Lumber-----	2	88	86
Other-----	275	1,463	1,188
Total-----	3,096	4,334	1,238
Land transportation:			
Railroad-----	200	296	96
Transit utility-----	73	173	100
Inter-city busses and trucks-----	40	57	17
Taxicab-----	3,363	5,425	2,062
Total-----	3,676	5,951	2,275
Experimental:			
Experimental-----	1,000	947	(-53)
Citizens-----	20	165	145
Miscellaneous-----	240	279	39
Total-----	1,260	1,391	131
Grand totals-----	53,301	57,350	4,049

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CHAPTER V. COMMON CARRIERS

1. COMMON CARRIER REGULATION
 2. TELEPHONE (WIRE AND RADIO)
 3. TELEGRAPH (WIRE, CABLE, AND RADIO)
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1. COMMON CARRIER REGULATION

A major purpose of the Communications Act is "to make available, so far as possible, to all the people of the United States, a rapid, efficient, Nation-wide and world-wide wire and radio communication service with adequate facilities at reasonable charges * * * "

To that end, the Commission is charged with regulating interstate and foreign communication by telephone and telegraph. The act requires that all charges, practices, and regulations in this connection be just and reasonable and nondiscriminatory.

At the same time, the Commission regulates the adequacy and quality of these services. No carrier may construct or acquire a facility of this character without Commission approval. By the same token, a carrier must obtain Commission approval of discontinuance or curtailment of such service. The Commission also regulates the interlocking of officers and directors, it being unlawful for a person to hold office in more than one carrier unless specifically authorized to do so. The Commission likewise passes upon applications of carriers for authority to merge.

The Commission prescribes the forms of records and accounts kept by these carriers, and has established uniform systems of accounts for them to follow. Carriers file public tariff schedules with the Commission, also annual reports and copies of all contracts with other carriers relating to traffic subject to the act.

The Commission receives all applications to land or operate submarine cables connecting the United States to other countries, and advises the President with respect to the granting of such licenses after receiving the approval of the Secretary of State.

The Commission licenses common carrier radio operators under provisions of the act which require the licensing of all persons engaged in radio transmission.

The Communications Act expressly protects wire and radio messages (with the exception of broadcast, amateur, and distress communication) from interception and use by unauthorized persons.

A large share of the Commission's common carrier work relates to rates and services of the Bell Telephone System, 63 independent tele-

phone companies, the Western Union Telegraph Co., and some 15 international carriers. The public has a large stake in these communication services since it pays well over \$2,500,000,000 a year for them.

COMMON CARRIER RADIO STATIONS

Nearly a thousand radio stations (not counting associated mobile units) are authorized in the common carrier services. This is an increase of more than 400 since the previous year. Figures for the past 2 fiscal years follow:

	1947	1948	Increase
General mobile.....	427	785	358
Experimental.....	81	128	47
Fixed public telephone.....	23	27	4
Fixed public telegraph.....	50	56	6
Total.....	581	996	415

COMMON CARRIER APPLICATIONS

More than 3,000 common carrier applications of all types were received during the year. Here is a summary of the fiscal years 1947 and 1948:

	Pending July 1, 1947	Received 1948	Disposed of 1948	Pending June 30, 1948
General mobile.....	43	1,135	1,018	160
Experimental.....	2	199	180	21
Fixed public telephone.....	23	138	148	13
Fixed public telegraph.....	95	339	368	66
Wire service extensions.....	17	498	490	26
Wire service reductions.....	121	841	724	238
Total.....	301	3,150	2,928	523

2. TELEPHONE (WIRE AND RADIO)

GENERAL

The telephone industry handled more business during fiscal 1948 than in any previous year. The Bell system, which owns about 85 percent of all telephones in service, handled over 34,500,000,000 exchange conversations and about 1,900,000,000 toll conversations during the year and currently is handling more than 125,000,000 conversations daily.

Industry expansion continued at the accelerated pace established following the war. The Bell system installed its 30 millionth telephone at Marshalltown, Iowa, on June 29, 1948. The General Telephone Corp. system during the year installed its millionth telephone. Telephone facilities are being added at an average rate of more than \$3,000,000 a day and the total gross investment now exceed \$8,000,000,-

000, reflecting a growth of about one-third during the past 3 years. More than 36,000,000 Bell and independent telephones were in service as of June 30, 1948, but there still remained a backlog of unfilled orders for approximately 1,500,000 instruments.

Rapid expansion was also felt in related telephone carrier activities, which include teletypewriter, private line, mobile radiotelephone, overseas radiotelephone, ship-to-shore radiotelephone, and radio broadcast and television program transmission services.

DOMESTIC TELEPHONE SERVICES

Construction of wire facilities.—The telephone industry expended about \$800,000 more in fiscal 1948 for new interstate wire and cable facilities than during the previous year. In addition to 13 applications on hand from the preceding year, the Commission received 380 new requests for wire line construction, acquisition, extensions, and leased projects. This included blanket application of American Telephone & Telegraph Co., and associated companies covering long lines construction. New construction authorized by the Commission in each of the past 5 years is indicated by the following table:

Fiscal year	Projects	Estimated cost	Sheath miles of cable	Tube miles of coaxial units	Conductor miles of open wire
1944.....	121	\$9,582,239	574.8	0	7,968
1945.....	210	70,091,140	2,378.3	7,902	2,963
1946.....	239	78,896,450	3,193.8	16,580	12,261
1947.....	289	126,325,771	5,587.7	23,490	15,976
1948.....	348	127,162,499	2,637.5	46,080	16,373

Based upon applications received by the Commission, the Bell system added about 2,100,000 miles of toll message channels during the year, which increased its previous total by 13.8 percent. About 90 percent of the new channels were provided by carrier systems.

The American Telephone & Telegraph Co. received authority to construct additional New York-Washington television circuits, two television circuits in each of the Washington-Charlotte, New York-Albany, Philadelphia-Chicago, Chicago-St. Louis, and Cleveland-Buffalo coaxial cable routes, and to install transmitting equipment at South Bend and Danville which are on the Philadelphia-Chicago-St. Louis television circuits. These scheduled coaxial facilities, when connected to existing and proposed microwave systems, will provide a comprehensive television network.

Coaxial cable.—The American Telephone & Telegraph's current program calls for 12,000 route miles of coaxial cable being installed by 1950. The Commission has authorized a total of 7,697 miles of coaxial cable (including 1,435 miles authorized during the past year at an estimated cost of \$42,498,000). Coaxial facilities, supplemented by

microwave radio relay systems, are designed to transmit a broad band of frequencies suitable for all types of services, including television. The transcontinental coaxial cable between Atlanta and Los Angeles was completed in November 1947, but at the close of fiscal 1948 was not yet available for television transmission.

Dial telephones.—The telephone industry is fast converting from manual to dial operation to handle mounting traffic loads. The Bell system has established dial operation at most of its exchanges in the larger cities, as well as many exchanges in smaller places. Today, 65.6 percent of all Bell telephones and 33 percent of all independent telephones are of the dial type. Conversion of toll boards throughout the country to dial operation is under way. This program, which was started in 1943 at Philadelphia, will require a number of years to complete. In the near future other cities, such as New York, Chicago, Cleveland, Oakland, Boston, Albany, Los Angeles, Indianapolis, and Baltimore will be so equipped.

Speed of service.—The Bell system reduced the average time required to complete a toll call from 2.4 minutes in June 1947 to 2.1 minutes in June 1948. An average 2-minute speed of toll service is its objective.

Rural telephone service.—The Bell system, during the fiscal year, installed slightly over 350,000 telephones in rural areas, bringing the total number of such telephones in its service, as of June 30, 1948, to approximately 2,200,000. Under the rural expansion program of the telephone industry, 40 percent of the farms in the United States have telephones. In the three southern regions (South Atlantic, East South Central, and West South Central), however, five out of six farms are reported as being without telephones.

Telephone recording devices.—On November 26, 1947, the Commission issued its final order in the proceedings involving the use of recording devices in connection with interstate or foreign telephone service. The order authorized their use subject to adequate notice to users that recording devices are being employed, such notice to be given by an automatic tone warning device producing a distinctive signal at regular intervals during the recorded conversation. The order, as subsequently amended, became effective on June 30, 1948, and directed the telephone companies to file no later than August 2, 1948, tariff schedules governing the use of recording devices in the manner prescribed.

Cable landing license.—The Commission received two requests for a presidential license for telephone cable landing operations. One sought to construct a telephone line across the Rio Grande River near Presidio, Tex., and the other was for a second submarine cable between Point Roberts, Wash., and the Canadian border. Both applications were pending at the end of the fiscal year.

Discontinuance, reduction, or impairment of service.—Fourteen applications were received to discontinue telephone service and 3 such applications were on hand, making a total of 17. Of these, 13 were granted and 4 were pending. Eight were Western Union requests to discontinue telephone service to cities connected to its long-distance telephone facilities. There were no remaining subscribers and adequate service was available through regular telephone facilities. Five applications sought to discontinue exchange or toll service in cases where another carrier planned to provide the same service. Four others were to discontinue telephone exchanges in sparsely settled areas and substitute extended area service, rural line service, or toll station service from nearby exchanges.

New developments.—At Media, Pa., the Bell system installed its first No. 5 cross-bar dial central office. This equipment is designed for communities of from 3,000 to 30,000 customers to handle exchange, intertoll, and tandem toll switching and to operate in conjunction with the Nation-wide toll dialing system. The Media installation also incorporates the first automatic message-accounting equipment which provides a ticket for machine billing of each toll call.

New types of cable sheath using plastics and a thin metal covering have been tested and, as a result, Alpeh cable having a sheath of aluminum and polyethalene is now being used. A new magnetic alloy known as supermalloy, which has the highest permeability of any known commercial magnetic material, has been developed for telephone equipment.

The newly announced transistor is a metal tube about the size of a shoelace tip containing two hair-thin wires touching a pinhead of a solid semiconductive material soldered to a metal base. It will serve as an amplifier or an oscillator tube using about one-tenth of the power of an ordinary flashlight bulb and amplifying about 100 times, thus tending to supplant vacuum tubes for many uses. A broad band carrier system—similar to the types J, K, and L—is being developed to operate over 2 pairs of wires in a single-cable sheath providing 12 telephone channels per system. Known as the N type carrier, it will greatly increase the capacity of the single cable routes.

Microwave relay systems.—The American Telephone & Telegraph Co. expanded its experimental microwave facilities. The New York to Boston microwave link, placed in service November 11, 1947, had its first commercial television use on June 9, 1948. In addition to this circuit, a New York-Chicago chain and a number of short microwave systems are planned. Two microwave systems for television programs only were scheduled for completion during the second half of 1948, linking Chicago with Milwaukee, and Detroit with Toledo. Microwave television program pick-up stations have been author-

ized for 11 Bell companies. They are concentrated in the areas of greatest television broadcast activity—New York and Los Angeles.

A regular basis of operation for microwave relay systems is contemplated in proceedings associated with certain presently experimental services. (See Safety and Special Radio Services.)

Short distance radiotelephone service.—Increasing interest has been shown in the use of very-high-frequency radio for short-distance telephone service, particularly in inaccessible areas where wire-line construction costs would be prohibitive. A few installations, on an experimental basis, have demonstrated that the use of radio in such places is practicable. Consequently, expansion of domestic short-distance radio telephone circuits is expected. Proposed rules to place this service on a regular basis were under consideration.

Mobile radiotelephone service.—Mobile radiotelephone service, whereby communications connections are offered between land-line stations and stations in vehicles, or between vehicles, has seen tremendous expansion since its introduction for public use in June 1946. The demand for this service far exceeds the capacity of facilities, with large backlogs of unfilled orders for mobile telephones in all the major cities. Installations of associated terminal facilities are approaching the point where telephone carriers will be able to furnish this service in most sections of the country.

Urban mobile service has been made available commercially by the telephone carriers in 60 cities, with installations in 22 additional cities in various stages of construction. Highway mobile commercial service has been opened in the vicinity of 95 communities, with construction under way in 37 additional areas.

Three types of communications are furnished by telephone companies: (1) general, which is the usual two-way telephone service between any telephone in the land-line system and a mobile unit via the base radiotelephone station with which the mobile unit is associated; (2) dispatching, a two-way service between wire telephones of a subscriber and specified mobile units of the same subscriber; and (3) signalling, a one-way signal from a land station to associated vehicles.

A new public telephone service which is competitive with the service of the established telephone companies is being offered in the mobile radio field by a number of nontelephone enterprises. It affords a third-party relay service which is not directly interconnected with the general land-line telephone systems. Messages between the mobile unit and the customer's land-line telephone are relayed by a dispatcher at the base station. This service was available on a commercial basis in 30 cities, with 88 additional stations under construction. The plan of operation makes its rates slightly lower than for the direct connection basis offered by the telephone carriers.

The mobile services, which have been operating under experimental authorizations, would obtain permanent status under rules proposed by the Commission. (See Safety and Special Radio Services.)

Service in Hawaiian Islands.—The Mutual Telephone Co. has installed and is operating nine transmitters in the 152- to 162-megacycle range in both its radiotelegraph and radiotelephone services in Hawaii (intra and interisland service). This equipment is capable of simultaneous telephone and telegraph operation and is intended to supplement Mutual's equipment now operating in the 30- to 50-megacycle range. Mutual was also authorized to operate two stations in the experimental service between 450 to 460 megacycles.

Coastal and Alaskan service.—Coastal harbor, coastal telephone, and Alaskan radio communications services are discussed in safety and special services because of their close relationship to radio aids to the safety of life and property. The public radiotelephone service inaugurated during the preceding year between various coastal harbor stations and aircraft expanded during 1948 and provision was made for the exchange of telegraph traffic as well.

INTERNATIONAL RADIOTELEPHONE SERVICE

Message toll telephone service.—Overseas message toll telephone service was reestablished with four countries where it had been suspended during the war and service was made available with seven countries for the first time. At the close of the year, radiotelephone service was in effect with 74 foreign countries outside North America. Negotiations were under way to reestablish service to other countries which were served before the war and to establish service to countries not previously served. In all cases where service was inaugurated or reopened, the rate pattern conformed to that outlined in the Commission's report for the fiscal year 1946. This service is now handling about 575,000 calls a year compared with around 50,000 calls annually in the pre-war period.

Program transmission and private line services.—Overseas broadcast program transmission service is available to 55 countries and short period private line service to 6 countries.

Equipment.—The American Telephone & Telegraph Co. has installed 13 additional transmitters at its fixed public radiotelephone stations in the United States to cope with the increasing demand for international telephone service. All but three of these transmitters are of the single side-band type, capable of twin- or triple-channel operation. Single side-band operation requires substantially less frequency space per channel than does the conventional double side-band system used for regular broadcast and long distance radiotelephone communication service. This is an important factor, in view of the crowded condition of the radio spectrum.

Docket cases.—On April 9, 1948, the Commission adopted its final report and order in docket 7555, wherein it renewed the license of RCA Communications, Inc., for its fixed public point-to-point radiotelephone station at Kahuku, Oahu, T. H., and denied the application of Mutual Telephone Co. for a new fixed public point-to-point radiotelephone station at Pupukea, Oahu, T. H.

Frequencies.—Almost all of the frequencies relinquished by the fixed public service to the military during the war have now been returned and, in addition, many new frequency assignments were made during the year. The Commission is participating actively in the work of the Provisional Frequency Board, created at the Atlantic City conferences, in engineering a new international frequency list which will contain all assignments for stations operating in the fixed public service.

Interference.—Increased use of radio for international communication and favorable conditions for high-frequency transmission caused a large number of interference complaints to be brought to the attention of the Commission. Notable among these, in view of the unusually long distance involved, were two cases concerning Mutual Telephone Co. operations in Hawaii on frequencies in the 30- and 40- megacycle range. Severe interference was experienced at several points in Texas and Oregon. It was eliminated by changing the frequencies used by Mutual.

International Telephone Conference.—In June 1948 the International Telephone Consultative Committee (CCIF) met at Stockholm, Sweden, to consider various technical telephone subjects, and proposals for certain changes in the International Telephone Regulations, in preparation for the Administrative Telephone and Telegraph Conference scheduled to be held in Paris in 1949. The United States was represented at the Stockholm session by an observer delegation, of which Commissioner Paul A. Walker was chairman.

RATES AND TARIFFS

Rate schedules.—At the close of the year, 227 telephone carriers had tariffs and concurrences on file with the Commission. During the year they filed a total of 23,177 tariff publications establishing or changing rates, regulations, practices, and classifications of service, including concurrences. Numerous irregularities in the rate schedules were corrected or eliminated through correspondence with the carriers.

Special permissions.—Forty-three applications for special permission to make changes in the tariffs or to file new tariffs to become effective on less than statutory notice or involving waiver of certain rule requirements were received. Of these, 42 were granted and 1 denied.

Other-line charges.—Bell system companies continued to make progress in establishing through rates for interstate message toll tele-

phone traffic interchanged with independent companies formerly handled on an other-line charge basis. As of March 1948, other-line charges applied on 320 telephone routes as compared with 393 on January 1, 1947.

Channels for FM program transmission.—As a result of a petition filed by the FM Association, an organization representing the FM radio broadcasting industry, an informal conference was held by the Commission in January 1948 with representatives of the association and American Telephone & Telegraph Co., regarding the availability of 15,000 cycle intercity transmission channels for FM broadcast programs, and appropriate rates therefor. Thereafter, the telephone company filed tariff schedules, effective February 18, 1948, establishing rates and regulations for intercity program transmission channels with a frequency range of approximately 50 to 15,000 cycles, suitable for use in connection with FM network broadcasting. Both the service and the rate structure involved are similar to the lower fidelity services heretofore offered for program transmission purposes, but 8,000-cycle service had been the highest grade provided previously.

Channels for TV program transmission.—As noted in the Commission's Thirteenth Annual Report, eight Bell companies had filed rates for local TV channels and associated station equipment. Rates for intercity TV channels, which had been filed by American Telephone & Telegraph Co. to become effective August 1, 1947, were withdrawn by the company for further study. At the close of the current fiscal year, 15 Bell system companies had filed rates for local channels. At the direction of the Commission, American Telephone & Telegraph Co. filed new tariff schedules on March 29, 1948, establishing rates and regulations for intercity TV channels and associated equipment, to become effective May 1, 1948. Since that time, 14 associated companies have also filed rates and regulations for intercity TV channels.

The basic schedules provide for the service on either a monthly basis 8 hours per day, 7 days per week, or on an occasional use basis. However, because of the shortage of intercity facilities available for this service, a separate schedule of charges based on a minimum use of 4 hours daily, 7 days per week, has been established for monthly service where allocation of usage between customers is necessary. It is expected that most of the monthly service for some time to come will be on an allocated usage basis. Another schedule of charges applies to intercity channels of less than 25 miles in length, which charges are approximately the same as those of the associated companies for local studio transmitter links.

The charges for intercity TV channel service, based on the rates filed in March 1948, would range from 23 to 39 percent lower than those provided in rates filed in August 1947. The Television Broad-

casters Association filed, on April 23, 1948, a formal petition with the Commission requesting that the intercity rates and regulations of both the Bell system companies and Western Union, which were also filed to become effective May 1, 1948, be suspended and that an investigation be made into their lawfulness. The Commission denied the request for suspension but ordered an investigation and hearing. The hearing commenced June 15, 1948, but was recessed until fall.

Great Lakes ship-shore telephone service.—On March 15, 1948, the Radiomarine Corp. of America filed amended tariff schedules to become effective April 19, 1948, establishing, for the first time, so-called ship station charges applicable to telephone messages to and from certain ships operating on the Great Lakes and handled through Radiomarine's coastal harbor radiotelephone station WBL. Among other things, the effect of the revised schedules was to increase substantially the charges to the public for such service. In addition to the reasonableness and lawfulness of the proposed increased rates, certain questions concerning the operations of Radiomarine were presented. Accordingly, the Commission suspended the amended tariff schedules and set the matter for investigation and hearing. At the request of Radiomarine, the scheduled midsummer hearing was postponed until fall.

Ship and aircraft telephone service.—The American Telephone & Telegraph Co. and Bell system companies filed amended tariff schedules, effective April 15 and May 15, 1948, respectively, revising the rate structure for telephone service between land points and ships at sea or aircraft en route, via Bell system coastal harbor and high seas radiotelephone stations. The rates for this service were formerly composed of a radio-link charge, of which one-third accrued to the ship or aircraft, plus a land-line charge. The revised rate structure is based on the air-line distance between the rate areas in which the craft and the land telephone are located. When the call to or from a ship or aircraft is via a coastal harbor station, a specific schedule of charges applies, of which no portion accrues to the ship or aircraft. For calls via a high seas coastal-telephone station, two schedules of charges have been established, one of which applies if the ship or aircraft is a carrier (one which renders communication service for hire), and a lower schedule if the ship or aircraft is noncarrier (one which does not render communication service for hire). The adoption of the new rate structure for ship telephone service has resulted generally in lower rates. Several larger passenger liners continue to render service on the radio-link basis. Rates for telephone service via coastal stations of other companies have not been changed.

Washington metropolitan area.—As noted in the Thirteenth Annual Report, the Chesapeake & Potomac Telephone Cos. of Virginia

and Baltimore City filed revised tariff schedules increasing the charges for certain interstate telephone calls between points in Virginia and Maryland within the Washington metropolitan area. These charges were suspended by the Commission pending a hearing as to their lawfulness and the telephone companies as well as the respective State commissions have questioned the Commission's jurisdiction in the matter. This is but one example of the jurisdictional problem that is arising frequently, where companies are converting certain short haul traffic from toll to extended area service arrangements. When such changes affect interstate toll traffic, the question arises as to whether the Commission retains jurisdiction to regulate the modified service.

COOPERATION WITH OTHER REGULATORY BODIES

Western Electric cost and price review.—Nearly all the materials and supplies purchased by the Bell companies are obtained from Western Electric Co., Inc., which is the manufacturing and supply department of the Bell system. The level of prices charged by Western Electric has an important impact on Bell telephone rates because these purchases either are charged to current expenses or are used for additions and replacements of plant which affect the investment in plant and depreciation charges. The importance of these prices is further emphasized by the fact that Western Electric sales to Bell companies amount to approximately a billion dollars a year. In many of the rate proceedings during the past year the State commissions have questioned the profits made by Western Electric on sales to affiliated telephone companies. As a result, in January 1948 a working committee representing this Commission and State commissions began a preliminary study of Western Electric prices, costs, and profits. The resulting report, issued shortly after the close of the fiscal year, is a preliminary review and summary of available data intended to assist regulatory bodies in appraising the reasonableness of Western Electric's earnings and prices and in determining the necessity for further investigation. While the study was in progress, Western Electric made two price adjustments which, according to the company's estimates, represented a net price reduction of approximately 8.6 percent on products of its manufacture, equivalent to an annual saving of approximately \$70,000,000 to Bell companies.

State telephone rate cases.—During the year, a large number of requests for increases in intrastate telephone rates was filed with state commissions by telephone companies. In the postwar period up to May 31, 1948, the Bell system companies applied for increases totaling \$242,000,000 in intrastate rates in 43 States and the District of Columbia. Increases aggregating \$138,000,000 were granted in 35 States and the District of Columbia and requests aggregating \$66,000,000 were pending before commissions in 15 States. Continuing its policy

of cooperation with State regulatory agencies, the Commission, to the limited extent possible, furnished information and assigned staff members at the request of State commissions. This participation consisted of conducting field studies jointly with State commission representatives and presenting testimony in several cases on matters of particular concern to this Commission in the exercise of its own regulatory functions. In addition, the Commission was consulted frequently on such regulatory matters as the Bell system license contract fees, depreciation, pension costs, and separation procedures.

Allocation of depreciation reserves of multi-State companies.—From time to time State public utility regulatory and tax authorities request Commission assistance in connection with determining the depreciation reserves applicable to individual States in the case of multi-State telephone companies. At the request of the Southeastern Association of Railroad & Utilities Commissioners, representing the States served by Southern Bell Telephone & Telegraph Co., joint studies were undertaken. These studies, which were nearing completion, will provide data on the service life expectancies and salvage recoveries for the various classes of plant which are necessary for allocating the company's depreciation reserve to the various States on an equitable basis.

Separation of property, revenues, and expenses.—Following intensive cooperative review and study during 1947, jointly with State regulatory body members and representatives of the Bell system and the non-Bell telephone industry (see Thirteenth Annual Report), a Separations Manual of Standard Procedures for Separating Telephone Property, Revenues, and Expenses was completed in October 1947. It is used by the Bell companies to allocate plant, revenues, and expenses among exchange, intrastate toll and interstate toll services for rate-making purposes, and in connection with the system's division of interstate message toll telephone revenues. The Commission, however, has not yet approved any specific method of separation, and docket 6328 (in which separation procedures are in issue) is still open. The Commission has offered no objection to the use of the separation procedures as set forth in the separations manual, for test purposes, in connection with Bell system division of revenues, pending decision in this docket.

The Commission continues to review the over-all monthly results of the division of interstate toll revenues among the Bell companies to check the accuracy of the application of the separation procedures to actual operations of the Bell system under the division of revenues contracts, and to test the reasonableness of the results obtained thereby.

Bell system license contracts.—Surveillance continued in regard to

the allocations of the alleged costs of the American Telephone & Telegraph Co. among the Bell companies advanced in justification of the collection from these companies of 1½ percent of their gross revenues in payment for certain services assertedly performed for their benefit by the parent company under the so-called license service contracts.

OTHER REGULATORY MATTERS

Uniform system of accounts.—Developments in public service communication indicate the need of changes in accounts or the establishment of new accounts to keep pace with new services and technical advances. Studies under way look to accounting classifications that will provide requisite information on plant investment involved and other costs of rendering service. Further improvement of the uniform system of accounts for class A and class B telephone companies with respect to income items is also under consideration. Procedures have been developed for more promptly detecting failures by carriers to comply with prescribed regulations relating to several types of accounting transactions of known recurrence.

Financing and refinancing.—Issuance of new securities by telephone companies continued in substantial volume. In addition to collaborating with the Securities & Exchange Commission by examining prospectuses filed with that Commission in light of accounting and financial data on file with this Commission, other matters of accounting were the subject of study after the securities had been issued. Increased activity continued with respect to the application of accounting regulations relating to refunding transactions, including the appropriate disposition of unamortized bond discount, premium, and expense.

Pensions and relief.—Because of the increase in wages and liberalization of benefits, relief and pension costs of communication carriers rose to a new high in 1947, reaching approximately \$118,000,000 annually for the Bell system alone, excluding social security taxes amounting to an additional \$23,500,000. Problems of pension accounting, therefore, continued to be of great significance, particularly in regard to (1) the reasonableness of costs, (2) the methods of determining the costs, and (3) the accounting for these costs. An extensive analysis of the Bell system's actuarial methods was tentatively completed, subject to further consideration and conference with the companies. In these studies attention was also directed to the question of the extent to which current payments into pension funds relate to past service of employees. Many inquiries relative to these pension problems were received from State commissions and labor groups.

Preservation of records.—Inquiry relating to the feasibility of microfilming carriers' records resulted in recommendation that this method of preserving records be approved for use by public utilities including communication carriers. Satisfactory standards for the use

of microfilm in the record-preservation program have been developed. A list of all records required in the exercise of regulatory functions was completed except for certain operating records that apply to particular situations.

New types of plant and services.—Preliminary and experimental procedures developed by telephone companies, in collaboration with the Commission, to account for plant, revenues, and expenses in connection with new communications services, including mobile and rural radiotelephone service and power-line carrier service, have been the subject of studies and conferences. It appears that continuation of the present practices of the companies with respect to maintenance of underlying records and subsequent establishment of new subaccounts may be preferable to establishment of new accounting classification. However, further observation of the development of these services is necessary before final determination can be made.

Restatement of plant on basis of original cost.—By general agreement, most of the Bell companies are completing restatement of their plant accounts on the basis of original cost with respect to acquisitions of plant made prior to the effective date of the present system of accounts. Disposition of amounts in excess of original cost recorded in the plant acquisition adjustment accounts are being charged directly to surplus or through appropriate amortization over reasonable future periods. During the year, adjustments made by telephone companies reduced the net book cost of plant through charges to income or surplus by more than \$2,000,000, thereby increasing the total original cost adjustments to more than \$37,000,000. Several cases involving controversial issues as to further adjustments were pending. Current acquisitions continued to be dealt with in accordance with the provisions of the uniform system of accounts.

Continuing property records.—Studies were continued jointly with representatives of State commissions and the telephone industry for the purpose of improving and simplifying continuing property record procedures. Field studies of a proposed method designed to improve the development of unit costs used in the retirement of certain classes of telephone plant are continuing. Further studies of the adequacy and effectiveness of continuing property record systems of certain large Bell telephone companies were undertaken during the year. Continued efforts were made to obtain full compliance by independent telephone companies with the continuing property record requirements, and negotiations were still in progress with 5 of a total of 50 such companies at the end of the year.

Depreciation.—With the exception of salaries and wages, depreciation expense is the largest item of annual operating costs incurred by telephone companies. For the Bell system alone, depreciation

charges for the calendar year 1947 were approximately \$245,000,000 whereas at the end of fiscal 1948 they were running at an annual level of over \$285,000,000 and were continuing upward. While the major part of this increase is directly attributable to the vast expansion in telephone plant at current high cost levels, some contribution also results from the upward trend in annual depreciation rates. This is due largely to the fact that, in efforts to reduce the backlog of unfilled orders for telephone service, the industry in many instances expanded existing facilities of old types which are scheduled for replacement as soon as modern equipment is available.

Studies were continued with respect to the propriety of proposed changes in depreciation rates. Carriers proposing substantial changes were in many instances requested to file supplementary data in support of estimated service lives and salvage values underlying the proposed changes. Investigations were conducted in the offices of some of the principal Bell companies to determine the reasonableness of rates and methods in that respect. There was also cooperation with the Committee on Depreciation of the National Association of Railroad and Utilities Commissioners.

TELEPHONE STATISTICS

Annual reports for the calendar year 1947 were filed by 138 common carriers and 28 controlling companies. They included 111 telephone carriers. Some selected financial and operating data of these telephone carriers for the year 1947, in comparison with 1946, are shown below:

Telephone carriers

Item	1946	1947	Percent increase or (decrease), 1947 over 1946
Investment in plant and equipment (as of Dec. 31).....	\$6,684,830,044	\$7,788,162,429	16.51
Depreciation and amortization reserves.....	\$2,350,308,973	\$2,513,997,977	6.96
Net investment in plant and equipment.....	\$4,334,431,071	\$5,274,164,452	21.68
Local service revenues.....	\$1,237,229,168	\$1,354,984,904	9.52
Toll service revenues.....	\$899,828,351	\$908,363,760	.95
Total operating revenues ¹	\$2,251,942,629	\$2,398,317,527	6.50
Operating expenses ¹	\$1,714,901,566	\$1,935,995,020	12.89
Taxes.....	\$273,262,223	\$260,829,709	(4.55)
Net operating income after all taxes.....	\$263,779,140	\$201,492,613	(23.61)
Net income.....	\$226,813,615	\$170,271,710	(24.93)
Dividends declared.....	\$198,831,671	\$203,519,238	2.36
Company telephones:			
Business.....	9,594,087	10,301,919	7.38
Residential.....	18,234,914	20,499,920	12.42
Average number of calls originating per month:			
Local ²	4,012,545,963	4,390,078,430	9.41
Toll ²	171,322,349	180,202,249	5.18
Number of employees at end of October:			
Male.....	525,523	556,887	5.97
Female.....	160,695	183,684	14.31
Total.....	364,828	373,203	2.30
Total pay roll for the year.....	\$1,306,053,484	\$1,435,902,570	9.94

¹ Intercompany general service and license fees and rents, amounting to approximately \$41,000,000 for 1947, and \$39,000,000 for 1946 have not been eliminated.

² Partly estimated by reporting carriers.

3. TELEGRAPH (WIRE, CABLE, AND RADIO)

DOMESTIC SERVICE AND FACILITIES

Western Union modernization program.—The essentials of Western Union's \$72,000,000 modernization program (see Thirteenth Annual Report) include substitution of automatic reperforator-switching for manual relay of telegrams at principal message centers and provision of telegraph channels by construction of microwave radio relay systems, leasing of facilities from the Bell system, and installation of wire carrier systems. The plan also calls for development of the use of telefax and telecars, expected to improve the speed and efficiency with which messages are handled at terminals. Substantial progress is being made in this project. Its completion, scheduled for the end of 1950, should result in an improved quality of telegraph service and operating economies estimated by the company at \$20,000,000 on an annual basis.

Domestic radiotelegraph.—During the year Western Union completed construction of its microwave triangle connecting New York, Philadelphia, Washington, and Pittsburgh. The New York-Washington leg is in service, with the other two legs in limited service, and full service was expected in the fall. Microwave circuits have proven satisfactory from a technical standpoint, and appear to offer advantages from the operating, maintenance, and economic standpoints, particularly on circuits carrying a very heavy traffic volume.

Construction of wire facilities.—The year brought 105 requests covering wire telegraph construction and extensions. Three such applications were carried over from the preceding year, making a total of 108. One hundred and four applications were granted. They covered the construction of 38,223 telegraph channel miles at a cost of \$260,365, and the lease of 70,508 telegraph channel miles at an annual rental of \$350,476 and terminal equipment at a cost of \$367,137.

Speed of service.—The Commission amended its rules and regulations to require Western Union, beginning June 1, 1948, to conduct and submit over-all or origin to destination speed of service studies. The first of these reports, covering the month of June 1948, shows that the average interval between the time a message is filed to the time it is delivered (or first attempt) was 43, 40, and 50 minutes when delivered by telephone, customer tie line and messenger, respectively. The time required by Western Union to relay messages through its 25 largest offices ranged between 9.4 and 12.8 minutes. The average was 10.5 minutes—an improvement of 0.5 minute when compared with the preceding 12-month period.

Discontinuance, reduction, or impairment of telegraph service.—During the year, 745 applications for reduction of office hours or closure of public offices were filed, in addition to 126 pending. With few

exceptions, these applications were filed by Western Union. Of this number, 598 were granted; 44 were withdrawn by applicant; 1 was withdrawn in part; 1 was denied; and 227 were pending. With respect to one of the applications granted, the Commission later requested restoration of the former hours of service. In five instances, authorized curtailments in service were not effected by the company. Service curtailed pursuant to grants of six of the applications was later restored voluntarily by applicant. In most cases where hours were reduced or offices closed, alternate service was made available.

On February 26, 1948, the Commission, by letter to Western Union, proposed the establishment of a standard to determine the maximum size of company-operated telegraph offices which, under normal circumstances, might be considered for conversion to teleprinter agency offices operated by persons engaged in nontelegraphic businesses. Need for such a standard grew out of pending and prospective applications by Western Union to effect conversions to agency operations. At the close of the year, comments from Western Union and others interested were under consideration.

After public hearings, Western Union received authority to discontinue six main telegraph offices in as many Ohio communities, and to substitute teleprinter operated agency offices to be operated by local telephone companies. In its report, the Commission concluded that the proposed changes would result in improved and additional services of value to those communities as well as to 116 other adjacent communities, with lower charges to the public in many instances.

RATES AND TARIFFS

Rate schedules.—As of June 30, 1948, 156 telegraph carriers had tariffs and concurrences on file with the Commission. They filed during the year 5,489 tariff publications establishing or changing rates, regulations, practices, and classifications of services, including concurrence. Numerous irregularities in the rate schedules were corrected or eliminated through correspondence with the carriers.

Special permissions.—During the year, 101 applications for special authorization to make changes in tariffs to become effective on less than statutory notice, or involving waiver of certain requirements of the Commission's rules, were received from telegraph carriers. Of these, 85 were granted, 14 denied, and 2 were not acted upon at the request of the applicants.

Other-line charges.—Further progress was made in the establishment of joint through rates for interstate telegraph traffic. As of March 1948, other-line charges applied on 386 routes as compared with 454 on January 1, 1947.

Government rates.—On the repeal of the Post Roads Act, effective July 26, 1947, pursuant to which special domestic message telegraph rates had been accorded the Federal Government, Western Union filed tariff schedules proposing the elimination of the differential between Government and commercial rates. The Commission suspended the operation of the schedules pending a hearing. Following the hearing, in which the Government opposed the abolishment of the discount, the Commission permitted the new schedules to become effective. As a result of this action, domestic Government message telegraph rates are now on the same level as commercial rates. Priority, however, is still accorded Government full rate and serial messages, if specifically requested by the sender. The repeal of the Post Roads Act did not affect international Government telegraph rates, and certain preferential Government rates are still operative in such traffic.

Western Union rate structure.—In spite of certain anomalies and discriminatory practices which were eliminated in 1946 and 1947, Western Union's rate structure still contains many inconsistencies, particularly with respect to the relationship between rates and distances. These deficiencies, in addition to the rate increases granted in 1946-47, have seriously weakened Western Union's competitive position in relation to the rapid communications services of the telephone companies and the United States air mail, and indicate that the rate structure should be revised so as to be better adapted to modern communication needs. In June 1947, Western Union informally submitted to the Commission a trial rate structure for domestic telegraph service which was based on extensive studies the company had been carrying on in cooperation with the Commission. It is expected that this informal submission will mature into a formal proposal for an over-all revision of the Western Union rate structure. The Commission is, therefore, maintaining detailed review of the carrier's message and rate studies as well as related operating data.

Channels for TV program transmission.—On March 30, 1948, Western Union filed proposed rates and regulations covering the transmission of television programs over its microwave radio relay system between New York City and Philadelphia, effective May 1, 1948. The minimum contract period is 1 year and basic service is furnished 8 hours daily, 7 days a week. The direction of transmission over these facilities may be reversed. (See also Channels for TV Program Transmission (broadcast) and Rates and Tariffs (telephone).

OTHER REGULATORY MATTERS (DOMESTIC AND INTERNATIONAL)

Depreciation.—In 1946 the Commission undertook a study with respect to land-line plant of Western Union (exclusive of former Postal Telegraph plant) for the purpose of determining the reasonableness of

the company's depreciation rates and practices. (See Thirteenth Annual Report.) As a result, a comprehensive report was prepared, embodying determinations of appropriate service lines, salvage values, depreciation rates, and reserve requirement. In February 1948, pursuant to section 220 (b) of the Communications Act, the Commission prescribed depreciation rates applicable to the several classes of Western Union plant. Western Union also agreed to increase its depreciation reserve by an amount of approximately \$10,000,000, and to adopt certain other remedial measures as recommended in the report. In connection with its modernization program, the company is retiring much of its plant before normal life expectancy is realized and is amortizing such costs not fully provided for. The Commission is maintaining appropriate surveillance. Reviews of the depreciation practices of international telegraph common carriers continued.

Continuing property records.—All but three of the radiotelegraph, wire-telegraph, and ocean-cable carriers have complied fully with the Commission's Rules and Regulations with respect to continuing property record systems. Joint accounting and engineering studies have been initiated to verify the data and to determine the effectiveness of the systems.

Pensions and relief.—The Commission continued its study of the carriers' pension arrangement and of revisions introduced by the carriers.

Reclassification of plant.—Western Union, in reclassifying its plant to conform to the effective system of accounts, has progressed to a point where completion is expected prior to January 1, 1949. During fiscal 1948 an upward adjustment in the depreciation reserve of Western Union was made, thereby bringing total adjustments of net book cost of plant since 1938 to approximately \$87,000,000 (exclusive of approximately \$43,000,000 pertaining to former Postal Telegraph plant). With respect to the plant of international carriers, reclassification in accordance with the system of accounts has been substantially completed.

LAND-LINE TELEGRAPH STATISTICS

Twenty-eight annual reports were received from wire-telegraph, ocean-cable, and radiotelegraph carriers for the calendar year 1947. Financial and operating items tabulated from Western Union reports for 1947 in comparison with 1946 are included in the accompanying table. The figures relate to the land-line operations of that company; data applicable to its cable operations are shown in the table concerning ocean-cable carriers included in the international section of this chapter.

The Western Union Telegraph Co.¹

Item	1946	1947	Percent increase or (decrease), 1947 over 1946
Investment in plant and equipment (as of Dec. 31).....	\$361, 618, 200	\$314, 275, 030	(13. 09)
Depreciation and amortization reserves.....	\$161, 825, 750	\$142, 664, 085	(11. 84)
Net investment in plant and equipment.....	\$199, 792, 450	\$171, 610, 945	(14. 11)
Transmission revenues.....	\$180, 242, 193	\$183, 834, 397	14. 72
Total operating revenues.....	\$175, 535, 860	\$199, 654, 193	13. 74
Operating expenses, depreciation, and other operating revenue deductions.....	\$183, 365, 261	\$185, 313, 959	1. 06
Net operating revenues.....	² \$7, 829, 401	\$14, 340, 234
Net income.....	² \$10, 030, 010	\$905, 970
Dividends declared.....
Revenue messages handled.....	³ 217, 665, 829	³ 220, 154, 500	1. 14
Number of employees at end of October.....	57, 644	53, 572	(7. 06)
Total pay roll for the year.....	\$137, 292, 715	\$138, 976, 068	1. 23

¹ Represents data for land-line operations. Figures covering cable operations included in another table

² Deficit.

³ Includes domestic haul of cable and radio messages (9,636,149 in 1946 and 9,851,556 in 1947).

INTERNATIONAL TELEGRAPH

International Conference

CCIT Conference.—The Commission was represented on the United States delegation to the International Telegraph Consultative Committee (CCIT), which met at Brussels in May 1948 to consider various technical subjects and proposals for certain changes in the International Telegraph Regulations, in preparation for the Administrative Telephone and Telephone Conference to be held at Paris in 1949.

Services and facilities

Circuits.—Radiotelegraph circuits were established between the United States and Tel Aviv, Israel, and Rhodes, Dodecanese Islands, during the year. A direct radiotelegraph circuit between New Orleans and Rio de Janeiro was opened by Tropical Radio Telegraph Co. late in 1947 as a result of the Commission's decision in docket 7723, hereinafter noted. Tropical also established communication with Kingston, Jamaica, which was one of the points involved in dockets 7094 and 7412, referred to in the 1947 Annual Report. Use of the Tangier relay stations of Mackay Radio & Telegraph Co. and RCA Communications, Inc., was extended to include communication with Israel and Rhodes, as well as with several other countries formerly served by direct operations only. Addressed program material is also being transmitted via Tangier to many points for the United Nations and the Department of State.

Docket cases.—Several applications for duplicating radiotelegraph circuits were filed during the year. Among these were filings by Mackay Radio & Telegraph Co. for authority to communicate with The Netherlands, Portugal, and Surinam, to which countries RCA Communications was operating radiotelegraph circuits from the

United States. Lengthy hearings, extending from April through June 1948, were held on these applications. Other hearings involving applications for new radiotelegraph circuits are scheduled for fiscal 1949. The Commission on December 4, 1947, adopted a final report and order in the British Commonwealth Circuits case, dockets 7094 and 7412 (referred to in the 1947 Annual Report). It divided the available circuits in the following manner: To RCA Communications, Inc.—Australia, New Zealand, Greece, and Union of South Africa; to Mackay Radio & Telegraph Company, Inc.—India, Palestine, and Saudi Arabia; to Tropical Radio Telegraph Co.—Jamaica. The Commission dismissed without prejudice applications to communicate with Ceylon, Hong Kong, and the Malay States (Singapore). The application of Press Wireless, Inc., to operate a press circuit with Australia was also dismissed without prejudice. The Commission, on November 28, 1947, adopted its final report and order in docket 7510, in which it denied Press Wireless modification of licenses to permit rendition of a domestic press, Government, radiophoto and program transmission service between applicant's east and west coast stations. On the same day, the Commission adopted its report in docket 7723, in which it denied Mackay's application to construct a new point-to-point radiotelegraph station at Meraux, La., for communication between New Orleans and Rio de Janeiro, Brazil, and Lima, Peru, and ordered a modification of license to Tropical Radio to operate a direct radiotelegraph circuit between its existing station near New Orleans and Rio de Janeiro.

New services.—RCA Communications and Press Wireless have instituted a new type of program transmission service which is being used by the United Nations for point-to-point transmission of material of an international broadcast nature to numerous foreign points. This service is on a unilateral basis and, after receipt at foreign points, is broadcast by local broadcast stations or networks, or is recorded for later broadcast. It augments the direct short wave broadcast services of the United Nations and the Department of State. Much of the material transmitted from New York is relayed via RCAC's Tangier relay station. Authorization has been granted to the 2 companies offering this service to transmit to over 30 countries in Europe, Africa, Asia, the Near East, Latin America, and the Pacific area.

Rates and tariffs

International rate case.—In the international telegraph rate case, docket 8230 (see Thirteenth Annual Report), the Commission on July 30, 1947, to meet the urgent revenue needs of the carriers, authorized emergency out-bound rate increases calculated to produce about \$5,485,000 additional annual revenue. It was estimated that corre-

sponding increases in in-bound rates would produce about \$1,055,000 more. None of the rate increases authorized by the Commission resulted in a rate out-bound from the United States in excess of the presently effective world-wide maximum of 30 cents per full rate word, 20 cents per code word, or an ordinary press rate of more than 6½ cents per ordinary press word.

Shortly thereafter, certain of the carriers requested reconsideration and further increases, alleging that their needs had not been fully met. The Commission reopened the proceeding and held further hearings in December 1947 and January 1948. On April 22, 1948, it issued its report in which it found that, on the basis of the record made at the further hearings, several of the respondent carriers were operating at a loss, and most of the others at a profit providing little more than a nominal return, and that this situation was expected to continue. In view of the urgent need for a substantial amount of additional revenue on the part of the international telegraph carriers, the Commission permitted additional general rate increases of an emergency nature. The additional out-bound rate increases were estimated to produce about \$3,188,000 in annual revenues, while further corresponding in-bound rate increases would produce about \$295,000 more. None of the increases authorized produced a rate in excess of 30 cents per full rate word. Certain controversial questions raised by the record remain for decision.

Multiple address press rates.—As part of the proceedings in docket 8230, Press Wireless, Inc., complained that its competitor, Mackay Radio & Telegraph Co., was furnishing multiple address press service at discriminatory and preferential rates, in that they were below the cost to Mackay of furnishing the services and that, in effect, the multiple address press service was being subsidized by Mackay's other services. In its April 22, 1948, report (docket 8230) the Commission found that Mackay's multiple address press rates were discriminatory and ordered Mackay to eliminate the discrimination. Mackay filed revised tariff schedules intended to comply with the Commission's order. Press Wireless, however, claimed that the discrimination had not been eliminated by the tariff changes. The Commission reopened the proceeding (in June 1948) to consider the matter further, and has included in the issues of the proceeding to be heard in the fall of 1948 the rates of all carriers offering multiple address press services.

Radiophoto service.—Rates were established for radiophoto service by RCA Communications, Inc., between the United States and China, effective November 5, 1947; Denmark via Stockholm, effective January 10, 1948; and New Zealand, effective June 1, 1948; by Mackay Radio & Telegraph Co. between the United States and Bombay, India, effective March 2, 1948; and by Press Wireless, Inc., between the United States and China, effective November 21, 1947.

Suspension of proposed telegraph rate changes.—The Commission, on two occasions during the year, suspended and set down for hearing proposed changes in international rates and regulations. Western Union proposed to reduce its rates for foreign contract press service (a customer-to-customer service) between New York and London. Since the proposed rates appeared to result in unlawful discrimination, the Commission ordered that they be suspended and investigated. Subsequently, the company was granted special tariff permission to cancel the rates under suspension and to establish in lieu thereof a new schedule which eliminated the objectionable features. Accordingly, the Commission dismissed the proceedings. RCA Communications proposed to permit the insertion in telegraph messages, without charge, of the phrase "Reply via RCA." Since it appeared that discriminatory aspects were involved and that problems would arise in settlements with foreign carriers, the Commission suspended the proposed provisions. Subsequently, RCAC cancelled its proposals.

Statistics

International telegraph (radio and cable) traffic, 1947.—The responses from cable and radiotelegraph carriers concerning international traffic indicates that 656,275,626 paid words were handled during the calendar year 1947. The out-bound traffic amounted to 337,131,185 words, and in-bound 319,144,441 words. An analysis of the traffic with the principal countries throughout the world is shown in the following table:

Country	Number of words	
	Out-bound from the United States	In-bound to the United States
Europe, Africa, and the Near East:		
Belgium.....	7, 167, 697	6, 600, 809
Denmark.....	2, 317, 844	2, 000, 189
Finland.....	833, 501	769, 192
France.....	18, 030, 010	13, 459, 282
Germany.....	7, 320, 885	9, 138, 650
Hungary.....	947, 408	768, 147
Italy.....	10, 372, 136	8, 876, 493
Netherlands.....	7, 262, 750	6, 256, 341
Norway.....	3, 166, 911	2, 363, 924
Portugal.....	3, 046, 319	2, 115, 015
Spain.....	3, 853, 629	3, 067, 102
Sweden.....	7, 299, 876	6, 507, 856
Switzerland.....	9, 703, 308	7, 375, 161
Union of South Africa.....	5, 179, 383	5, 047, 929
Union of Soviet Socialist Republics.....	9, 063, 304	8, 213, 870
United Kingdom and Eire.....	61, 814, 856	69, 577, 600
All other countries.....	29, 125, 034	25, 936, 101
Total.....	186, 504, 851	168, 073, 661
West Indies, Central, North, and South America:		
Argentina.....	14, 891, 162	13, 157, 352
Bolivia.....	1, 038, 062	639, 246
Brazil.....	13, 894, 662	15, 126, 090
British West Indies.....	3, 241, 627	2, 994, 146
Canada.....	6, 580, 196	6, 228, 745
Central America.....	7, 264, 975	6, 442, 929
Chile.....	3, 131, 645	2, 841, 470
Colombia.....	5, 109, 584	4, 240, 573

Country	Number of words	
	Out-bound from the United States	In-bound to the United States
Cuba.....	10,897,927	12,229,917
Dominican Republic.....	1,358,740	1,379,747
Ecuador.....	1,706,701	1,092,892
Haiti.....	773,071	632,302
Mexico.....	2,559,423	2,536,109
Netherlands West Indies.....	1,169,422	1,227,602
Peru.....	2,600,706	1,907,850
Puerto Rico.....	3,558,263	3,492,258
Uruguay.....	2,107,836	1,518,360
Venezuela.....	6,451,912	6,522,511
Virgin Islands.....	145,309	141,707
All other countries.....	1,067,526	748,397
Total.....	89,548,754	88,100,203
Asia and Oceania:		
Australia.....	5,343,639	5,228,848
China.....	12,788,746	10,907,557
Hawaii.....	11,914,213	8,473,094
India.....	8,735,818	8,371,001
Japan.....	2,622,259	5,388,303
Philippines.....	11,597,183	14,218,329
All other countries.....	7,646,179	9,636,928
Total.....	60,648,087	62,224,060
Miscellaneous.....	429,493	746,517
Grand total.....	337,131,135	319,144,441

International telegraph (radio and cable) financial and operating data.—Certain financial and operating data obtained from the annual reports filed by telegraph (radio and cable) carriers engaged in international traffic, for the calendar year 1947 in comparison with 1946, are shown in the following two tables:

Radiotelegraph carriers

Item	1946	1947	Percent increase or (decrease), 1947 over 1946
Investment in plant and equipment (as of Dec. 31).....	\$34,015,568	\$36,614,331	7.64
Depreciation and amortization reserves.....	\$16,676,631	\$17,828,421	6.91
Net investment in plant and equipment.....	\$17,338,937	\$18,785,910	8.35
Message and other transmission revenues.....	\$20,601,801	\$20,582,509	(.09)
Total operating revenues.....	\$21,775,900	\$21,741,440	(.16)
Operating expenses, depreciation, and other operating revenue deductions.....	\$21,550,904	\$22,611,828	9.56
Net operating revenues.....	\$224,996	\$1,870,358	(931.30)
Income taxes.....	\$200,454	\$262,494	30.95
Net income.....	\$313,034	\$1,573,781	(602.75)
Dividends declared.....	\$872,000	\$5,000	(99.43)
Revenue messages handled: ¹			
Domestic-service classification ²	96,871	63,558	(34.39)
Foreign-service classification ²	10,476,469	11,204,102	6.95
Marine.....	629,253	857,030	36.20
Number of employees at end of October.....	5,969	6,261	4.89
Total pay roll for the year.....	\$17,832,605	\$19,368,981	8.62

¹ Excludes domestic haul of foreign, insular, and marine messages to avoid duplication.

² International messages (primarily Canadian and Mexican) transmitted in accordance with carriers' rules governing domestic traffic are included under Domestic Service Classification. Insular messages are included under Foreign Service Classification.

³ Deficit.

Ocean cable carriers

[Including cable operations of the Western Union Telegraph Co.]

Item	1946	1947	Percent increase or (decrease), 1947 over 1946
Investment in plant and equipment (as of Dec. 31)	\$95, 129, 932	\$96, 061, 650	0.98
Depreciation and amortization reserves	\$60, 078, 811	\$61, 522, 573	2.40
Net investment in plant and equipment	\$35, 051, 121	\$34, 539, 077	(1.46)
Transmission revenues:			
Domestic-service classification	\$844, 716	\$812, 228	(3.85)
Foreign-service classification	\$20, 391, 963	\$20, 755, 463	1.78
Total operating revenues	\$22, 691, 417	\$23, 772, 389	4.76
Operating expenses, depreciation, and other operating revenue deductions	\$21, 366, 862	\$24, 357, 552	14.00
Net operating revenues	\$1, 324, 555	¹ \$585, 163	(144.18)
Income taxes	\$344, 759	\$301, 933	(12.42)
Net income	\$522, 784	¹ \$1, 141, 364	(318.32)
Dividends declared	\$2, 148, 066	\$1, 381, 005	(35.71)
Revenue messages handled:			
Domestic-service classification	696, 820	663, 491	(4.78)
Foreign-service classification	10, 645, 119	11, 511, 512	8.14
Number of employees at end of October	5, 681	6, 247	9.96
Total pay roll for the year	\$12, 664, 251	\$14, 309, 199	12.99

¹ Deficit.

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CHAPTER VI. RADIO OPERATORS, AMATEUR, AND CITIZENS RADIO SERVICE

1. GENERAL
 2. COMMERCIAL RADIO OPERATORS
 3. AMATEUR RADIO SERVICE
 4. CITIZENS RADIO SERVICE
 5. STATISTICS
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1. GENERAL

Commercial radio operators and the amateur and citizens radio services are distinguished by the fact that they comprise individuals who personally operate radio transmitters. It is of further interest that commercial and amateur operators constitute the largest of all radio groups in number of authorizations, while the new citizens radio service holds promise of being a numerically large class. Operator authorizations collectively now exceed 504,000, which is an increase of more than 64,000 during the year.

In addition, these operators present complex problems of individual flavor, differing from considerations in other categories, since each applicant and licensee views the situation on the basis of his own needs and circumstances. Increased activity in these fields caused the Commission, early in the fiscal year, to create a Radio Operator and Amateur Division within the Bureau of Engineering. It consists of three branches, each having to do with a service in these classifications.

2. COMMERCIAL RADIO OPERATORS

As part of its obligation to regulate all persons in the United States engaged in communication or transmission of energy by radio, the Commission has established six classes of commercial radio operator licenses and a special authorization limited to operation of radio transmitters on private aircraft.

Unless exempted by the Commission's rules, persons operating radio stations licensed by the Commission must hold commercial radio operator licenses of the proper grades. The term "commercial radio operator" is used to differentiate between those who operate radio stations for a livelihood, as compared with the amateur radio operator whose interest in radio is solely personal and without pecuniary interest. Thousands of commercial operators are employed by broadcast, coastal harbor, coastal radiotelephone and radiotelegraph, ship radiotelephone and radiotelegraph, railroad, state, and municipal police, fire, and other stations.

With the exception of restricted radiotelephone operator permits and aircraft radiotelephone operator authorizations, commercial radio operator licenses are issued only to applicants who successfully complete prescribed examinations. These examinations are designed to establish that applicants possess a knowledge of technical matters and of regulations essential to the proper discharge of their duties. Licenses are divided into two main groups, authorizing operation respectively of radiotelegraph and radiotelephone stations. These general groups are classified according to the demonstrated qualifications (and in some cases experience) of the operators, with authorizations varying from limited and nontechnical operation of packaged transmitters to unlimited operation, installation, service, and maintenance of complicated broadcast or shipboard radiotelegraph installations.

The postwar increase in the number of licensed commercial radio operators continued, although the rate of increase dropped to some extent toward the close of the year. More than 347,800 persons held commercial operator authorizations as of June 30, 1948, an increase of nearly 18,800 over the preceding year.

A total of 26,652 examinations were given during the year for new licenses other than the aircraft radiotelephone operator authorization and the restricted radiotelephone operator permit, as a result of which 13,988 new licenses of the higher grades were issued. In addition, 5,699 restricted radiotelephone operator permits resulted from examinations in which the applicants qualified for that permit but failed to obtain a higher class of license. Commercial operator examinations are given and the examinations are graded in the Commission's field offices, which also issue new and renewed licenses.

The year saw the end of many wartime special regulations and provisions, as well as progress in modernization of the radio operator examination and license structure. Commission orders of the 77 and 128 series were allowed to expire, as having fulfilled their original purposes and being no longer necessary. The 77 series, the last of which (77-H) expired June 30, 1948, provided for the renewal of operator licenses without a showing of the normally required renewal service as a convenience to many license holders who were in the armed forces during the war. Since it was felt that ample time has been allowed all ex-service men to secure the required renewal service since demobilization, the Commission restored the former renewal service requirements, effective July 1, 1948.

The 128 series, the last of which (128-C) expired December 31, 1947, permitted renewal of expired operator licenses which were valid on or subsequent to December 7, 1941, the holders of which were in war service or who, because of civilian assignments outside the United

States in connection with the war effort, were unable to file timely applications for renewal. The Commission allowed the normal provisions of its rules to again become effective; namely, that application for renewal shall be made during the last year of the license term.

The Commission continued to authorize its district offices to waive the 6 months' experience requirement for sole or chief radiotelegraph operators of cargo ships so that operators without the requisite experience might be assigned to vessels otherwise unable to sail for lack of qualified personnel. In addition, the Commission, in September 1947, adopted an order which had the effect of reinstating or extending all temporary limited radiotelegraph second-class operator licenses which had expired, or would otherwise expire by their own terms prior to July 1, 1948, so that all such licenses (with the exception of those whose normal 5-year term would extend beyond that date) would expire June 30, 1948. The shortage of ship radiotelegraph operators being no longer acute at the end of the year and the Commission's authority to waive the 6 months' experience requirement having also expired at that time, both of these special provisions were allowed to terminate June 30, 1948. However, the Commission has requested from Congress that it be granted continuing authority to waive the 6 months' experience requirement to cope with any such shortage which may develop in the future. The issuance of temporary limited radiotelegraph second-class operator licenses was discontinued on June 30, 1946. These were nonrenewable licenses, valid only in the marine radiotelegraph service, which were issued for a 5-year term and as an emergency measure during the war years to applicants who could not fully qualify for the class of license normally required for that service.

Because of wartime and postwar demands on Commission personnel, it was impossible, until fiscal 1948, to revise the written examinations for the various grades of commercial licenses. This, coupled with the many new uses and applications of radio, necessitated that the examinations, which were last revised in 1939, be completely rewritten in the light of the current state of the radio art. At the close of the year, approximately one-half of this project has been completed and the examinations for the various grades of radiotelephone operator licenses revised to include newer material such as microwave and frequency modulation techniques. The examination for the radiotelephone first-class operator license now contains, for the first time, questions on such matters as television scanning and pulsing, FM bandwidth and deviation factor, and directional antenna power gain and distortion areas, to test the qualifications of applicants for that class of license for service in any kind of broadcast station. The remainder of this project—namely, revision and modernization of examinations

for the various grades of radiotelegraph licenses—is scheduled for completion during the 1949 fiscal year. Meanwhile, revision will be made from time to time as necessary to keep abreast of any new uses to which radio transmissions are put.

As part of its program of modernizing the operator examination and license structure, the Commission has considered establishing a separate series of three licenses and examinations for operators of the various classes of broadcast stations, these licenses to be graded according to technical knowledge and ability and operating duties. Primarily because of disagreement between labor and management on the desirability and feasibility of such a license structure, the Commission held several conferences and a public hearing in an endeavor to reach a solution acceptable to all concerned. Decision was pending at the close of the year.

In connection with the modernization of commercial operator examinations, it was necessary to revise the publication Study Guide and Reference Material for Commercial Radio Operator Examinations which is sold by the Government Printing Office as a guide in preparing for the examinations. A further revision is contemplated to include, among other things, pertinent extracts from the Atlantic City (1947) revision of the general radio regulations which will become effective January 1, 1949.

Modification of Commission order 133 to permit specially trained unlicensed personnel to make antenna tuning and coupling adjustments to transmitters in mobile units, under certain specified conditions, was pending at the end of the year. Some provisions, modified in accordance with acceptable proposals, were being incorporated into the individual parts of the Commission's rules governing the various services concerned. As a result, it is anticipated that order 133 can be cancelled in the very near future.

Pending establishment of permanent rules to govern the installation and operation of shipboard navigational radar, the Commission established temporary rules extending the operator requirements previously applicable while these installations were in an experimental category; namely, that the user of the equipment, as a navigator, need not be a licensed radio operator, but that any repairs or adjustments which might affect the proper operation of the equipment should be made by or under the supervision of the holder of a first- or second-class commercial radio operator license, either radiotelephone or radiotelegraph. The matter of whether the above provisions should be made a part of the permanent rules was still under consideration, with a possibility that it might be found necessary to redetermine the general requirements, authority, and responsibility of licensed commercial radio operators in connection with all classes of transmitters, including radar.

The need for bringing the Commission's rules governing commercial radio operators in step with the new era in electronics received considerable study. While it was not possible to accomplish a complete and major revision, several matters requiring immediate attention were covered by amendments to the existing rules. For example, the Commission, in June 1948, made it possible for an operator operating two or more stations at different locations to post a verified statement concerning his license at locations other than the one where his original was on display. Concurrently, the Commission liberalized its rules with respect to an operator engaged in the installation service and maintenance of radio transmitters at two or more stations by providing that he need only carry his license or a verification card while performing such duties. It further provided that these operators should make a written record of the work actually performed in each case and should properly identify themselves in that record as the operators responsible for the proper operation of the transmitters. These changes greatly reduced confusion and attendant routine clerical work on the part of both industry and the Commission. It is anticipated that a major portion of the commercial radio operator rule changes made necessary by the growth of the radio industry may be accomplished during the next fiscal year, and that it will then be possible to rearrange and simplify them to facilitate reference by the operators concerned.

Relaxation of the Commission's rules to allow applications for restricted radiotelephone operator permits to be filed by mail has proved popular with the industry in general and particularly with small boat operators and various law enforcement, conservation, and public utility agencies. At the close of fiscal 1948, a total of 278,061 such permits were outstanding, of which number 77,816 had been issued during the year.

The Commission's practice of issuing a special form of radio operator's license, known as the aircraft radiotelephone operator authorization, has been a convenience to private flyers. The number outstanding at the end of the fiscal year approximated 80,000. This authorization, which covers operation of licensed radiotelephone stations in aircraft only, is issued upon personal applications to any Commission field engineering office or to any of the over 2,400 CAA certified pilot examiners who have been designated by the Commission for that purpose. Such issuance at airfields is a particular convenience to operators of private planes.

3. AMATEUR RADIO SERVICE

The amateur radio service provides an opportunity for self-styled radio hams throughout the country not only to communicate with one another but also with other amateur stations throughout the

world. Amateurs operate primarily because of their interest in radio equipment and in the techniques of operating radio stations and handling communications by radio. They are not permitted to transmit or receive messages for pay, or to broadcast entertainment.

The amateurs continued to constitute one of the largest and most active radio services. Operators and stations were each nearing the 80,000 mark. The number of stations is now slightly higher than the number of operators. This is due to the fact that in some instances licensees have more than one station, either for their own use or, in their names, for amateur clubs or military training groups.

At the close of the year 71,952 new 5-year amateur station licenses and 71,441 amateur operator licenses had been issued. It was estimated that there were 6,482 old station and operator licenses which were renewed or revalidated by Commission orders, but which have not been replaced by new licenses. For their convenience, amateur operators are examined at the Commission's field offices, but their papers are graded at the Washington office, which issues the licenses.

Amateur operators differ from those in other services in that the former are largely interested in radio as an avocation rather than as a vocation, and in many cases amateur radio is the radio man's hobby. Although nominally a means to communicate with each other and, while doing so, conduct programs of experimentation and self-improvement, amateur radio furnishes training and experience for those who enter commercial radio fields. It also provides an invaluable reservoir of trained radio personnel available to the military in time of war. It has in many instances furnished the sole medium of communication in peacetime when normal facilities have been disrupted. Amateur radio has been the source and proving ground of many outstanding advances in radio technique.

Amateur radio station licenses are granted only to United States citizens who have qualified for and hold valid amateur radio operator licenses attesting their ability to properly operate stations in this service.

To promote the activities of this important group, the Commission has, insofar as possible, assigned harmonically related groups of frequencies for amateur use. With only three minor exceptions, these assignments are exclusive to the amateur service.

During the year, the amateur frequency assignments achieved a greater degree of stability than at any time since the end of the war. They were permanently incorporated in the amateur rules coincidental with the cancellation of the series of orders returning, from time to time, the amateur privileges as frequencies could be released from war-time use. Certain minor changes in frequencies and emissions were made. One of these was provision for greatly increased use of narrow

band frequency modulation. The resulting reduction of interference by amateur radiotelephone to broadcast reception has justified the establishment and extension of the 1-year experimental period.

Return to peacetime conditions eliminated the need for orders 132 and 132-A, and they were cancelled March 10, 1948. As a result, amateur licensees are no longer required to notify the Commission when engaging in operation away from the normal fixed station location on frequencies above 25 megacycles, but conversely fixed station operation at other than the licensed location in excess of 4 months is prohibited.

Provisions of the wartime number 77 series of orders were extended by adoption of a footnote to section 12.27 of the amateur rules to the effect that the existing prewar licenses would not require the showing of use as a prerequisite to renewal but, instead, that all postwar licenses would so require. This had the dual effect of eliminating much confusion as to requirements and also protected many whose military service would otherwise have prevented renewal. It also eliminated considerable paper work for both the amateur and the Commission.

Early in the year it was recognized that both wartime and postwar developments in radio presented problems not previously experienced. Therefore, studies of the needs of the service from an administrative standpoint and with a view to guiding amateur radio operation in a manner which would be in the best interests of the licensees and the public were inaugurated and pursued. Resultant actions by the Commission which affected the amateur included the development of a more efficiently processed amateur license form authorizing either operator or station privileges or both, and amendments of the rules to define and clarify the term "remote control" as applied to this service, including the conditions under which such authority may be granted; to clarify the prohibition against broadcasting; to define permissible one-way transmissions; to prohibit the use of codes and ciphers in amateur communications; to liberalize the time factor requirement of previous holding of an amateur license as a prerequisite to qualification for amateur class A privileges; and to simplify the procedure which licensees are required to follow when answering notices of violations. Provisions were made for utilization of newer techniques, and authorizations granted for the study of others. These included narrow band frequency modulation, suppressed carrier-single side band transmission, pulse-time modulation, radio remote control of transmitters, grounded-grid power amplifiers, and others.

The amateur service is vitally interested in the vexing problem of interference to television reception, and special consideration was given to this situation as it concerns the radio amateur. The actions of the Atlantic City telecommunications and radio conferences were

reviewed in order that their applicable requirements might be reflected in *Commission administration* of the amateur service.

As a result of observations and investigations by the Commission's monitoring stations and by personnel in the field during the year, citations were issued for irregularities in the operation of some amateur stations. The vast majority of these violations were of a *minor nature* and were promptly rectified by the licensee after receipt of official notice. However, a few cases were serious enough to warrant suspension of operator licenses and revocation of station licenses. Several unlicensed stations operating in the amateur frequency bands were located and appropriate action taken.

Amateur operators experimented with narrow band frequency modulation in the lower bands throughout the year. Considerable interest was evinced in single side band suppressed carrier transmissions as well. Information on both types of emissions is being studied for the purpose of evaluating their respective merits for possible permanent provision in the amateur rules.

As usual, the amateur fraternity gave unstintingly of its facilities and services during the year's emergencies. Outstanding was amateur network functioning in connection with the hurricane that struck Florida, Mississippi, and Louisiana during September, and the disastrous floods which ravaged the Northwestern Pacific States in the late spring and early summer of 1948. Such contributions to the national welfare by the amateur are made without regard to the financial loss and physical hazard which he often faces at such times and are resulting in a still greater degree of military and public appreciation of his value in communication emergencies.

4. CITIZENS RADIO SERVICE

The citizens' radio service, still on an experimental basis, is designed to provide for short-distance radio communication, radio signaling, and control of remote objects by radio for private or personal use by citizens of the United States.

Individuals in general will benefit from the convenience of utilizing two-way portable radio equipment for private radio service between relatively close points where regular communication facilities either are not available or are not practicable. Examples of such use would be on farms and ranches, recreation areas, etc.

This potential service should be of particular value to parties requiring quick contact, such as physicians while en route in their cars, hospitals in communicating with ambulances, volunteer fire departments, and members of similar groups concerned with the protection of life and property.

Similarly, dairies, laundries, department stores, and other business

organizations having a dispatching problem might be able to use this service for communicating to and from their vehicles if distance and interference considerations are not too great.

Other uses indicated by inquirers are delivery trucks to shops, waterway dredging operations, construction crews to base, private aircraft to home, private boat to clubhouse, steeple jack aloft to helper on ground, directing parade activities, parking-lot operators, assembly lines, and various other activities which would be aided by a localized private radio-communication system.

In October 1947 technical requirements for the citizens' radio service were promulgated and became effective December 1, 1947. They established regulations governing transmitters and set up a procedure for obtaining type-approval for equipment submitted to the Commission for tests. This service already had been allocated the frequency band 460 to 470 megacycles, which is excellent for portable transmitter use since the high frequency makes feasible the design of small compact equipment.

However, technical developments had not reached the state where low-cost equipment could be manufactured for this new service and it was generally uneconomic to modify war surplus walkie-talkies for the purpose. The technical standards are spurring manufacturers to develop suitable equipment for prospective users prior to the actual inauguration of the service. Considerable progress has been made in technical design, and the Commission on March 22, 1948, issued its first type-approval certificate to a manufacturer of equipment specifically designed for citizens use.

The operation of citizens radio stations to date has been conducted on an experimental basis under class 2 experimental licenses. Data obtained from such experimental operation aided the Commission in drafting operating requirements intended to complete part 19 of its Rules and Regulations Governing the Citizens Radio Service. Adoption of this part would establish the service on a regular basis.

Simplified station licensing procedures which eliminate the need for licensed radio operators, except where telegraphy is used and adjustments to equipment are made, are important provisions of these proposals. Other regulations would establish minimum specifications for equipment to insure frequency stability and noninterference to other services.

In 1948 the number of experimental operators in the citizens service increased from 12 to 48, and applications rose from 20 to 165.

5. STATISTICS

A comparison of authorizations for commercial radio operators, special aircraft radiotelephone, amateur operators and stations, and

citizens experimental for the past 2 fiscal years follows, based upon revised figures and estimates:

	1947	1948	Increase
Commercial operators.....	329,022	347,803	18,781
Aircraft radiotelephone.....	42,100	80,000	37,900
Amateur operators.....	70,500	77,923	7,423
Amateur stations.....	70,000	78,434	8,434
Citizens ¹	12	48	36
Total.....	511,634	584,208	72,574

¹ This service not yet established; figures represent class 2 experimental authorizations only.

CHAPTER VII. FIELD ENGINEERING AND MONITORING

1. GENERAL
 2. INSPECTIONS
 3. OPERATOR EXAMINATIONS
 4. MONITORING
 5. TECHNICAL OPERATION
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1. GENERAL

The Commission's field engineering work is conducted along two major lines, one covering enforcement activities and the other monitoring. For this purpose the Field Engineering and Monitoring Division consists of four branches, namely, the Inspection and Operator Examination Branch, the Monitoring Branch, the Technical Operations Branch, and the Administrative Branch.

Enforcement activities, which include inspections, examinations, investigations, handling interference complaints, etc., are accomplished out of 23 district offices, 6 suboffices, and 4 ship offices.

A total of 10 primary monitoring stations and 11 secondary monitoring stations provide a fixed monitoring network which is supplemented by mobile monitoring units. Monitoring activities consist of frequency measurements, signal recordings, long-range direction finding, interference and unlicensed operation investigation, and the technical aspects of design, construction, and operation of monitoring equipment.

All field engineering activities are coordinated through 9 regional managers. In fiscal 1948 the Field Engineering and Monitoring Division had a personnel complement of 434 for the field service and 61 for departmental service.

A total of 143 automobiles, of which 54 are equipped with monitoring and direction-finding apparatus, were used in connection with the field work. These cars traveled a total of 1,054,007 miles in the performance of duties.

2. INSPECTIONS

BROADCAST STATION INSPECTIONS

During the year, Commission field engineers made 668 initial inspections of new broadcasting stations. Of this number, the majority were standard (AM) stations. There were also a number of new FM stations and a few new television stations, all of which were on equipment tests. The initial inspections were made to determine whether these stations had been constructed in compliance with their authori-

zations and with due regard to technical requirements necessary for rendering a satisfactory public service.

Continuing regular inspections were made of broadcasting stations throughout the United States and its possessions to assure that broadcasting met the required level of technical operations. A total of 2,176 broadcast-station inspections were made during the year.

SHIP INSPECTIONS

Some relaxation in ship-inspection work occurred due to the emphasis placed on the inspection of new broadcasting stations and to the urgency of performing special field work on technical projects. In the enforcement of prescribed safety standards, field engineers conducted nearly 12,500 ship radio station inspections. The following table compares the number of ship inspections conducted during the last 5 fiscal years:

Number of ship inspection

	1944	1945	1946	1947	1948
United States ships.....	10, 157	13, 843	12, 765	11, 717	10, 117
Foreign ships.....	1, 252	1, 888	1, 023	2, 231	2, 364
Total.....	11, 409	15, 731	13, 788	13, 948	12, 481

It will be noted that, due to the workloads in other categories, the number of ship inspections declined somewhat. However, there was an increase of approximately 35 percent in the number of discrepancy notices served. This is attributed to the decline in the degree of enforcement resulting from the indicated decrease in the number of ship inspections performed in 1948.

Number of discrepancy notices served

	1944	1945	1946	1947	1948
United States ships.....	7, 413	8, 677	8, 365	8, 040	10, 519
Foreign ships.....	257	714	404	1, 190	1, 688
Total.....	7, 670	9, 391	8, 769	9, 230	12, 207

Of the violations discovered on board ships in 1947 and 1948, 4,433 were cleared during inspections in 1948 as compared with 5,128 cleared during 1947 inspection. This indicates greater seriousness in the type of violations discovered during 1948 and that for this reason they could not be cleared during inspection.

Violations cleared during inspections

	1944	1945	1946	1947	1948
United States ships.....	5, 393	7, 580	6, 830	4, 673	3, 925
Foreign ships.....	187	229	129	455	508
Total.....	5, 580	7, 809	6, 959	5, 128	4, 433

INSPECTION OF OTHER RADIO STATIONS

With the introduction of new forms of communication by radio, a large increase was noted in the number of stations other than broadcast, ship and common carrier which were subject to inspection. A total of 14,605 inspections of such land stations were made in 1948 as compared with 9,294 inspections the year previous. In 1947, technical deficiencies numbering 2,706 were reported; in 1948 this number was 4,308.

The increasing load on the field inspectional force resulted in the adoption of a new policy which provides for regular inspection of stations at irregular intervals.

3. OPERATOR EXAMINATIONS

During 1948 the Commission's offices in Washington and in the field acted upon 99,820 applications for the various classes of commercial radio operator licenses and authorizations as follows: 26,652 applicants who did not fail a code test during examination, 855 who did, and 5,512 applicants who failed the examination for higher grades of licenses and were issued the restricted radiotelephone permit in lieu thereof. In addition to the candidates who were examined, 65,097 applications for restricted radiotelephone operator permits (by declaration) were received and honored, as were 1,704 applications for aircraft authorizations. This compares with 67,401 applications received and acted upon during 1947. Amateur classes A and B operator applicants totaling 18,528 were examined in 1948 as compared with 12,994 during the fiscal year 1947.

Plans were made for the field offices to receive and process applications for licenses in the new citizens radio service (see Radio Operators) after that service is opened to the public on a regular basis.

4. MONITORING

Monitoring activities are of two main categories: service to industry, the general public, and Government organizations; and enforcement of radio laws.

A major task of monitoring today is to locate sources of interference. Causes of interference have kept pace with the growth of radio facilities. Interference to one or more radio services may come from a transmitter operating improperly or, in fact, from almost any piece of electrical equipment releasing energy. The Commission's field staff has traced sources of interference to medical apparatus, power lines, drawbridges, and even miniature aquariums. In one case last year serious interference to an aviation frequency on the west coast was traced to an electronic dryer in a furniture factory located in Pennsylvania.

SERVICE TO INDUSTRY, PUBLIC, AND GOVERNMENT

A total of 1,445 major monitoring cases were acted upon in 1948. This compares with 1,112 the previous year. Additionally, a total of 19,859 minor problems were handled by monitoring, the majority of which were based upon *interference complaints*. These interference cases have kept pace with the number of radio stations crowding the spectrum.

One hundred and seventy requests were received for assistance in locating lost planes. This represents an increase over 1947 when 124 requests were received. Safety of life conferences acknowledge the necessity of long-range direction finding in the over-all aviation safety program and recognize the Commission's contribution in this field.

In carrying out the above services, the Commission's monitoring engineers employ not only several types of direction finders, but also frequency measuring, signal analysis, and high speed code recording and audio-recording equipment. Mobile units, which are in effect small monitoring and direction-finding stations, are used in the final stage of running down interference that has been localized.

The success of Commission monitoring depends upon a rapid and flexible communication network. Several problems can be handled at one time, or concentration put on one particular problem. The monitoring system operates so that primary monitoring stations, secondary monitoring stations, investigative offices, and mobile units are welded together in a *service enforcement arm*.

ENFORCEMENT BY MONITORING

The listener to or user of a radio signal is often more concerned with the characteristics of the signal than with the means or method of its generation. It is for this reason that radio laws and regulations must concern themselves with the effects of radio signals. Monitoring for enforcement attempts to scrutinize the operation of all radio transmitting installations and, in addition, the many pieces of equipment which employ electric energy for manufacturing or medical purposes.

Additionally, there is an international consideration. Orderly and cooperative radio operation throughout the world, as well as in our own country, depends upon radio stations conforming to international and domestic technical requirements. The United States is required by international agreement to check the emissions of domestic stations to see that they keep within assigned frequencies and use authorized power.

The policing of one-half million signals is, therefore, a huge task, even if the full quota of 183 men assigned to the monitoring stations could be employed. Maintenance, construction, and other work reduces the effective policing force. However, because of long years of

experience, thousands of improper operations have been noted and corrected.

During 1948, as a result of monitoring activities, 15,064 advisory, violation, and other notices were served on radio stations or radio operators. This was slightly below the 1947 total of 16,483.

Unlicensed activity, perhaps spurred to some extent by the availability of war-surplus transmitters, continued to increase. The number of illegal radio stations located during the year totaled 153, an increase of 26 percent over 1947. Of these stations, many were operated without malicious intent, but some were of a more serious nature. All were either a source of interference to important communications services or posed a threat to the Commission's responsibility to maintain order in the radio spectrum.

Several cases involved false distress calls, much to the concern of the Government services charged with air and sea rescue operations. One example was an unlicensed station in Washington, D. C., which operated on a frequency assigned to the aeronautical services. Posing as a distressed aircraft on two occasions, this station caused military authorities to send out crash boats and planes in a search for a mythical plane. Field investigation located this station and, after obtaining admissions of unlicensed operation, the case was turned over to the Department of Justice.

Illegal stations located by mobile units included two which were involved in transmission of false distress signals on aircraft frequencies, several unlicensed broadcasting stations, aircraft, taxi, small craft, and amateur-band stations. Five of these cases were referred to the Department of Justice and two convictions were obtained.

Part of the increase in the work load on the Commission's mobile investigative units is attributable to the mounting number of cases involving the very high frequencies. Further increase is expected in view of the activities in the higher reaches of the radio spectrum and the increasing availability of VHF equipment.

The volume of television receiver sales and public interest in television broadcasting has resulted in adding greatly to the number of interference complaints received by Commission offices. Investigation and resolution of interference to television receivers involve more complexities than met with in aural reception.

5. TECHNICAL OPERATION

The rapid development of new VHF and UHF services requires suitable receiving and measuring apparatus being available at the field offices and monitoring stations. Consequently, the past year witnessed the procurement of new apparatus or modifying available equipment for the purpose.

Because of the specialized nature of the different services, and the rapid utilization of varying methods of modulation or other means of transmission, a difficult problem is presented to provide suitable receivers for general coverage purposes in the VHF, UHF, and SHF ranges of reception. It has not yet been met by any commercial equipment manufacturer, the most suitable receiving equipment presently available being a military counterradar receiver, a number of which have been located and purchased for the field.

There was an increase in the number of requests for technical information from various divisions of the Commission and from other agencies. Because of the additional technical apparatus delivered by manufacturers, or constructed by field personnel, it was possible to honor most of these requests. Accordingly, a large number of engineering studies, investigations, and measurements were performed in the field, being approximately evenly divided between district offices and monitoring stations.

For example, at the request of the Standard Broadcast Division, the field personnel checked the field intensity of signals emitted by 53 directional antenna systems to determine whether or not these signals agreed with those specified in the station license authorization. Also, a complete field strength survey was made of one standard broadcast station, and several other surveys determined ground conductivity between pairs of stations and whether or not the conductivity varied with the direction of transmission of the signal. Surveys were made of the student carrier current stations of eight colleges to obtain information on such operations.

General monitoring stations and the Baltimore district office are continuing long-range broadcast signal intensity recording. In addition, certain monitoring stations are recording field intensities of VHF signals on a long-time basis. During the past year an unprecedented number of requests for special recording of VHF and UHF tests and other transmissions were received, and most were accommodated.

In preparation for the Safety of Life at Sea Convention at London, the electrical characteristics of the antennas of a large number of ships of all types were measured, including their actual radiating efficiency, the directional pattern, if any, and similar data. Measurements of the relative intensity of emission of harmonics from all classes of stations were made and are being continued to provide information on which to base engineering recommendations for standards of harmonic suppression for all types of services.

Other technical studies have been conducted to determine means of meeting new problems, particularly with regard to improvement of present apparatus, new types of operations, and extension of the

normally used spectrum into higher frequencies. Continuing interest in increasing the accuracy of the Commission's direction finding system has resulted in the practical development of wide frequency range transformers for use in the fixed monopole direction finders which, when substituted for the wide frequency range vacuum tube coupling units previously used, give increased sensitivity and accuracy with less maintenance and attendant difficulties. Other minor changes and adjustments and more careful attention to all phases of maintenance and operation have also increased the accuracy of the rotating type direction finders.

During the past year a total of 83 new projects were initiated, an increase of almost 100 percent over those of fiscal 1947. In addition, many projects initiated during previous years were continued for part or all of 1948.

During the last fiscal year it was necessary to arrange to move two primary and seven secondary monitoring stations. A new primary monitoring station was placed in operation at Livermore, Calif., replacing the previous San Leandro station. It was constructed within the \$47,000 appropriated for land and buildings.

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CHAPTER VIII. TECHNICAL STUDIES

1. TECHNICAL INFORMATION DIVISION
 2. LABORATORY DIVISION
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1. TECHNICAL INFORMATION DIVISION

During its twelfth year of operation, the Technical Information Division extended its long-term projects, inaugurated new projects, and enlarged its sphere of activities to meet the increased demands of a rapidly developing industry. As technical consultant to the Commission, the industry, and the public, this division continued to conduct special studies and to collect and analyze basic data relative to various communication problems, and to make the resulting scientific information available for guidance in the promulgation of general rules and the determination of practical engineering standards.

The Commission is represented by the chief of the division or his alternate on a number of important standing committees. Among these are the Executive Council of the Central Radio Propagation Laboratory (CRPL), the Executive Committee of the International Scientific Radio Union (URSI), Papers Review Committee of the Institute of Radio Engineers (IRE), Radio Propagation Committees of the Institute of Radio Engineers and of the Radio Manufacturers Association, Aircraft Radio and Electronics Committee of the Aeronautical Board, Preparatory Committees for the International Radio Consultative Committee (CCIR), the Society of Automotive Engineers-Radio Manufacturers Association (SAE-RMA) Vehicular Interference Committee, and Committee C63 of the American Standards Association (ASA). The chief of the division also served as second alternate for the Chairman of the Commission on the President's Scientific Research Board which dealt with the broad aspects of the national research program.

WAVE PROPAGATION RESEARCH

In order that the most logical allocation of frequencies may be achieved, it is necessary that the Commission be fortified with reliable knowledge of the propagation characteristics of radio signals throughout the usable spectrum. Allocations within services as well as the determination of channel widths, distance separations, service ranges, interference zones, and power limitations must be preceded by a knowledge of wave propagation. Such knowledge is best obtained through practical field measurements and the careful engineering analysis of the resulting data. It is the primary function of the Tech-

nical Information Division to obtain these data and furnish highly reliable answers to the technical problems involved. In arriving at such answers the division obtains some information from the industry and other Government agencies but more largely from practical research projects such as those enumerated below:

Medium frequency projects

Sunspot cycle.—Solar activity has a profound effect upon radio wave propagation. During daytime hours, standard broadcast stations are only heard over relatively short distances. At night, clear channel skywave signals may be heard from distant States as well as from Mexico and Canada. The sunspot cycle covers a period of about 11 years. The Commission's sunspot cycle project was inaugurated in 1938 and is still active. Continuous recordings of broadcast signals are being made at Baltimore, Md.; Grand Island, Nebr.; Portland, Oreg.; and Powder Springs, Ga., and from time to time at other points. This information is needed to aid the interpretation of data taken in various years. For example, the Canadian Department of Transport wishes to extend the latitude dependent skywave curves for 1944 and *United States latitudes to Canadian latitudes using data from 1947*, a year of high sunspot numbers.

Weather effect on groundwave field intensities.—The relationship between field intensities and weather conditions was the subject of a detailed study in which signal levels received at Baltimore from station WCAU in Philadelphia were compared with official weather bureau data including pressure, temperature, and humidity for those locations. While the study is far from complete, it is apparent that a close correlation exists between signal strength and weather conditions, especially temperature and precipitation. The need for further study is indicated as it is evident that the degree of protection from interference that stations afford each other is by no means constant in time.

Atmospheric noise.—Continuous field intensity recordings of atmospheric noise between 200 and 1600 kilocycles were continued as in previous years. The information received from these recordings is analyzed and correlated with thunderstorm data and the results are used in the preparation of a series of noise maps to show characteristic variations with the time of day and a percentage of time for each frequency band and for various latitudes. These maps are used in estimating the signal level required to provide an acceptable radio service in the presence of atmospheric noise and hence, the possible service ranges when interference from other stations is absent. Because of the pressure of other duties the analysis of data and preparation of new maps were not undertaken during fiscal year 1948.

Skywave pulse transmissions.—Radio signals which travel from the

transmitter to the receiver by way of the E or F layers of the ionosphere are characterized by multiple reflections of different relative amplitudes and phases, depending on the distance or range of reception. To determine action and effect, pulses transmitted by selected broadcast stations are received simultaneously on loran receivers at distances of 500 to 2,000 miles. The pulses appearing on the oscilloscopes of each receiver are photographed at equal intervals of time. The results are then analyzed to determine the signal intensities exceeded for various percentages of the time for the components arriving by way of one, two, three or more reflections or hops from the ionosphere. Considerable additional field data were obtained during the past year. Analysis indicates definitely that the nature of skywave propagation is not so simple as it is generally assumed to be in the design of directional antennas. Additional measurements, possibly over a rather long period of time, may be necessary before definite conclusions can be made. The work is being carried over into the next fiscal year.

Daytime skywave reflections.—The charts from the automatic field intensity recorders of the sunspot cycle recording project contain a great deal of incidental propagation information. Drawing on these data, a fairly extensive study was made in connection with docket 8333, of the occurrence of daytime skywave in the standard broadcast frequency band. Although the data utilized were somewhat meager, the nature of this phenomenon was probably adequately established for present allocation purposes. If appreciable changes should be made in the Commission's allocation policies, it is anticipated that this study might require further expansion.

VHF and UHF projects

Due to the rapid development of new radio services and the consequent demand for channels in these higher frequency regions, it has been necessary to accelerate currently active projects and inaugurate new studies with a view to providing the Commission with reliable technical information upon which to base allocation plans and promulgate new rules and engineering standards.

Very high-frequency recording.—During the year the number of VHF field intensity recording installations were increased to approximately 15 units. Recorders were in operation at Searsport, Maine; Millis, Mass.; Philadelphia, Pa.; Laurel, Md.; Powder Springs, Ga.; South Miami, Fla.; Allegan, Mich.; Grand Island, Nebr.; Portland, Oreg.; San Leandro, Calif.; Honolulu, Hawaii; and Trinidad, British West Indies. The measurement of field intensities from FM, television, and other VHF stations was accelerated in order to obtain data needed in the preparation of standards for predicting good service ranges and objectionable interference ranges.

The increased sunspot activity during the year brought an increase in long-distance transmission, via the F2 layer of the ionosphere, in the frequency range from 30 to 60 megacycles. Unusually strong signals from eastern stations were recorded at Portland and San Leandro. Information gained from these measurements verified the Commission's early contention that long-distance interference would be detrimental to FM reception in the frequency range near 50 megacycles. A report (exhibit No. 54) on this project was entered in the proceedings in docket 8487, November 10, 1947.

A long-term project started in 1946 involving the simultaneous recording of signals from WBAM at New York on 47.1 and 106.5 megacycles at Princeton, N. J., Southampton, Pa., Laurel, and Powder Springs was concluded during the year. The data thus obtained were analyzed to determine the instantaneous distribution of field intensities. This distribution made it possible to evaluate the reliability of service and the magnitude of interfering fields for locations and over distances for which the measurements were made. An engineering report (exhibit No. 52) with distribution charts and field intensity curves was also introduced in the docket 8487 proceedings. This report, at the time of release, represented the best available technical information on actual propagation measurements on the frequencies involved.

Approximately seven other investigative projects of somewhat similar nature were under way during the year. The analysis of the resulting data represents a serious problem in that the job is tedious and requires more man-hours than are available to the division. Much valuable information is presently concealed in the large quantity of unanalyzed recorder charts on hand.

SPECIAL STUDIES AND MISCELLANEOUS ACTIVITIES

The Technical Information Division carries on a variety of special technical studies and miscellaneous activities. These duties include the maintenance of a technical library, the furnishing of a free consulting service to industry and the public, the promulgation of standards, widespread committee work, and many special studies.

Many of the latest engineering textbooks and scientific periodicals have been added to the library listings. Personnel of this division represented the Commission on eight important standing committees and a number of subcommittees. Much technical information was furnished to the various bureaus and divisions of the Commission as well as to consulting engineers and the public. The list of special studies is too numerous to be tabulated here, but includes the suppression of harmonic and spurious radiations, standards and limitations for carrier current systems, single side band, suppressed carrier studies, shipboard antenna measurements, VHF and UHF vacuum

tube studies, etc. Due to limited personnel, only those studies which carry the highest priority can be undertaken by the division.

2. LABORATORY DIVISION

GENERAL FUNCTIONS

The Laboratory Division maintains a laboratory at Laurel, Md., for technical research and investigation through laboratory methods to aid the Commission in allocating frequency bands and establishing and revising engineering standards and regulations for new as well as existing radio services.

Typical of the Laboratory Division's activities would be (1) tests of types of transmitters to determine whether interfering signals are emitted on other than the frequency actually employed, and (2) tests of receivers to determine how close together the Commission might place stations without the listener receiving several stations at the same time.

In general, the division's activities concern the type of equipment rather than individual units. An attempt is made to anticipate interference problems and to have remedial measures taken at the manufacturing end rather than to make individual investigation after a general interference occurs. If this procedure is not followed while a system is developing a multitude of units may be placed in operation, after which the only remedy may be a patchwork solution. Some of the laboratory activities engaged in during the year are outlined below:

INDUSTRIAL HEATING, DIATHERMY, AND MISCELLANEOUS EQUIPMENT

In the last decade radio frequency heating for industrial, medical, and other miscellaneous uses has expanded to such an extent that the kilowatts of equipment used by this group exceeds the total transmitter kilowatt power required for radio communication. Such equipment employs the same frequencies used by the communications industry and if the equipments are not properly designed and operated severe interfering signals will be emitted. Some of these units use power far in excess of the 50 kilowatt maximum permitted our broadcast stations.

In order to cope with the interference situations the Commission adopted part 18 of the Rules and Regulations covering industrial, scientific, and medical service, effective June 30, 1947. Subsequently, the Commission added a portion to part 18 covering miscellaneous equipment.

The Laboratory Division has maintained contact with the industrial heating industry, having representation on a number of committees of the American Institute of Electrical Engineers and the Institute of Radio Engineers. Standards of measurement techniques and inter-

ference reduction procedures are presently under consideration by these committees.

Diathermy apparatus used for medical therapy involves a large number of units of identical type. During the fiscal year manufacturers made 50 submissions of models for laboratory-type testing. Approval was recommended for 16 types found to meet the Commission's requirements. Industry has cooperated to the end that interference suppression even greater than that required by present rules has been obtained in many cases.

A considerable number of devices employing radio frequency energy and capable of serious interference were not clearly within the industrial heating or diathermy classification, so they were covered by the subsequent Miscellaneous Devices section of part 18. Included in this group are electric signs which employ radio frequency power for excitation of gases, also radio cookers and welding equipment. The welding equipment industry has been granted an extension of the effective date of the application of part 18 to permit reduction of the emission of interfering signals to the permitted limits.

It is believed that the steps taken to control radio interference from noncommunication users of radio devices is of great importance not only to the rapidly developing television service and other civilian radio communication services, but also a great protection to the frequencies utilized by the armed services. This aspect merits particular consideration in view of the importance of the industrial heating devices to production of military material.

STRATOVISION

The Laboratory Division made observation and measurements of the television transmissions made from aircraft flying at 25,000 feet in experiments by the Westinghouse Electric Corp., in cooperation with the Glenn L. Martin Co. Few other tests of this nature were made due to the fact that the aircraft installation became available only during the latter part of the fiscal year. However, this activity is continuing in view of the impact that stratovision may have on the whole television broadcasting structure by offering a possible method whereby video could be received over wider areas than it is now possible to serve.

TELEVISION

A number of studies in the laboratory and in the field were made to determine the interference situation with regard to television. One series of tests indicated that the original allocation for the joint use of television bands by television broadcasting and other services was untenable in that the television viewer in many areas could expect numerous interferences or distortion in reception. (See also Television.)

Other studies were directed at interference problems due to oscillator radiation (both high frequency and sweep) from television receivers. The industry is considering methods to reduce such interference. Another study was made of the harmonic radiations of TV stations as well as from other stations emitting harmonics on TV channels.

To illustrate the basic reasons why television is so subject to interference: An ordinary voice broadcast channel is only 10 kilocycles wide. At 1,000 kilocycles this channel width is 1 percent of the operating frequency. A television channel is 6 megacycles wide. At 60 megacycles this is one-tenth of the operating frequency. So the probability of interference to the TV channel is 10 times as great. This, coupled with the fact that the eye is more critical than the ear, requires stricter engineering control over conditions causing interference.

FM BROADCAST

The increase in the number of operating FM stations resulted in interference developing between FM stations in the same locality. Many FM broadcast receivers were tested to determine the separations required between stations if these receivers were to be free of interference. A study, undertaken to determine the role of the multipath problem in causing distortion of FM programs, is continuing. (See also frequency modulation (FM) broadcasting.)

MOBILE SERVICES

The influx of police, fire, power company, taxicab and other mobile radio operation in the spectrum near 150 megacycles invited numerous interference problems. The laboratory measured some of this equipment. The results indicated that separations in excess of those anticipated would be required until further improvements could be made in equipment. Delineating the problem has spurred manufacturers to improve designs, but there is still need to prevent unimproved equipment getting into general use and thereby greatly restricting the number of stations which can be licensed.

EQUIPMENT TESTING

Numerous devices submitted by manufacturers were tested to determine whether they would meet existing Commission requirements or, if no requirements were specified, whether the equipment could be operated to serve the purpose for which it was intended without causing interference or degradation of other communications services. These cases were typical:

Tests were made on one frequency and modulation monitor. This is a device used by standard broadcast stations to indicate that they

are on their right wave length and that the voice or music is properly impressed on their carrier. After certain adjustments this particular device was recommended for type approval.

A number of short-wave receivers were tested in considering frequency spacing of stations in the international broadcast service.

Tests of a number of types of transmitters employed in the mobile service revealed that many could operate in such a fashion as to spread over a much wider part of the spectrum than they were supposed to. Steps are being taken to insure operations of existing equipment within their own channels and new rules are under consideration to require incorporation of devices which will assist in keeping them within bounds.

Several types of transceivers proposed to be used in the Citizens Radio Service were submitted during the year. The first units tested did not comply with the rules, but after extensive changes they were resubmitted and type approval granted. The first such type approval was announced March 23, 1948.

Type approval of proposed equipment has proved mutually advantageous to industry and the services affected, besides reducing the field monitoring workload.

FIELD SURVEYS

A large number of broadcast stations employ directional antennas to keep them from interfering with other broadcast stations. With the increase in the number not only of standard broadcast stations, but also of FM and TV stations, the presence of other radio towers has affected the effectiveness of certain of these directional systems with a resultant increase in interference. The laboratory conducted two surveys of this nature during the year and began a continuing series of measurements to determine other factors which may reduce the interference suppression below the values required.

CALIBRATION OF APPARATUS

The Field Engineering and Monitoring Division uses a large amount of technical equipment. The Laboratory Division must calibrate this apparatus for accuracy. The laboratory also maintains its own instruments in a highly accurate state. In addition, some equipment used by others in obtaining data submitted in applications was compared on the accuracy of the measurements. These latter tests covered only items for which the National Bureau of Standards was not prepared to calibrate at the time. During the year eight field intensity sets and seven signal generators were calibrated. Calibration measurements were also made at seven recording installations in various parts of the country.

LOW-POWER DEVICES

This group consists of devices not expected to cause interference because of the low power employed. Examples are radio-operated garage-door openers, miniature broadcast stations, and devices for remote control of models. Of the devices tested, a considerable portion was found capable of causing radiation greater than that permissible. The manufacturers decided either to give such new products further study or withdraw others from sale.

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APPENDIX

1. FIELD OFFICES
 2. PUBLICATIONS
 3. TREATIES AND OTHER INTERNATIONAL AGREEMENTS
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1. FIELD OFFICES

The Commission's field offices are as follows:

BUREAU OF ENGINEERING

FIELD ENGINEERING AND MONITORING DIVISION

<i>Regional offices</i>	<i>Headquarters</i>
North Atlantic.....	506 Federal Bldg., New York 14, N. Y.
South Atlantic.....	411 Federal Annex, Atlanta 3, Ga.
Gulf States.....	332 U. S. Appraisers Bldg., Houston 11, Tex.
South Pacific.....	323-A Customhouse, San Francisco 26, Calif.
North Pacific.....	801 Federal Office Bldg., Seattle 4, Wash.
Central States.....	876 U. S. Courthouse Bldg., Chicago 4, Ill.
Great Lakes.....	1029 New Federal Bldg., Detroit 26, Mich.
Hawaiian.....	609 Stangenwald Bldg., Honolulu 1, T. H.
Alaskan.....	52 Post Office and Courthouse, Anchorage, Alaska.

<i>District offices</i>	<i>Address</i>
1.....	1600 Customhouse, Boston 9, Mass.
2.....	748 Federal Bldg., New York 14, N. Y.
3.....	1005 U. S. Customhouse, Philadelphia 6, Pa.
4.....	508 Old Town Bank Bldg., Baltimore 2, Md.
5.....	402 New Post Office Bldg., Norfolk 10, Va. (ship office), 106 Post Office Bldg., Newport News, Va.
6.....	411 Federal Annex, Atlanta 3, Ga. (sub office), 214-218 Post Office Bldg., Savannah, Ga.
7.....	312 Federal Bldg., Miami 1, Fla. (sub office), 409-410 Post Office Bldg., Tampa 2, Fla.
8.....	400 Audubon Bldg., New Orleans 16, La. (ship office), 324 Courthouse and Customhouse, Mobile 10, Ala.
9.....	324 U. S. Appraisers Bldg., Houston 11, Tex. (sub office), 329 Post Office Building, Beaumont, Tex. (ship office), 406 Post Office Bldg., Galveston, Tex.
10.....	500 U. S. Terminal Annex Bldg., Dallas 2, Tex.
11.....	539 U. S. Post Office and Courthouse Bldg., Los Angeles 12, Calif. (sub office), 320 Customhouse and Courthouse, San Diego 1, Calif. (ship office), 326 Post Office and Court- house, San Pedro 1, Calif.
12.....	323-A Customhouse, San Francisco 26, Calif.
13.....	406 Central Bldg., Portland 5, Oreg.
14.....	801 Federal Office Bldg., Seattle 4, Wash.
15.....	521 Customhouse, Denver 2, Colo.

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<i>District offices</i>	<i>Address</i>
16-----	208 Uptown Post Office and Federal Courts Bldg., St. Paul 2, Minn.
17-----	838 U. S. Courthouse, Kansas City 6, Mo.
18-----	246 U. S. Courthouse, Chicago 4, Ill.
19-----	1029 New Federal Bank Bldg., Detroit 26, Mich.
20-----	328 Federal Bldg., Buffalo 3, N. Y.
21-----	609 Stangenwald Bldg., Honolulu 1, T. H.
22-----	322-323 Federal Bldg., San Juan 13, P. R.
23-----	7-8 Shattuck Bldg., Juneau, Alaska (suboffice), 53 Post Office and Courthouse, Anchorage, Alaska.

Primary monitoring stations

Alegan, Mich.
Grand Island, Nebr.
Kingsville, Tex.
Millis, Mass.
Santa Ana, Calif.
Laurel, Md.
Livermore, Calif.
Portland, Oreg.
Powder Springs, Ga.
Honolulu, T. H.

Secondary monitoring stations

Searsport, Maine.
North Scituate, R. I.
Spokane, Wash.
Twin Falls, Idaho.
Richmond, Fla.
Lexington, Ky.
Broken Arrow, Okla.
Bay St. Louis, Miss.
Fort Richardson, Alaska.
Anchorage, Alaska.
Point Maldonado, P. R.

COMMON CARRIER DIVISION FIELD OFFICES

Atlanta, Ga., 515 First National Bank Bldg.
New York, N. Y., 604 Federal Office Bldg.
San Francisco, Calif., 316 U. S. Customhouse.

BUREAU OF ACCOUNTING FIELD OFFICES

Atlanta, Ga., 515 First National Bank Bldg.
New York, N. Y., 624 Federal Office Bldg.
St. Louis, Mo., 407 Old Customhouse.
San Francisco, Calif., 316 U. S. Customhouse.

LAW BUREAU FIELD OFFICES

New York, N. Y., 604 Federal Office Bldg.
San Francisco, Calif., 100 McAllister St.

2. PUBLICATIONS

Following is a list of Federal Communications Commission publications which may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., unless otherwise indicated:

<i>Title</i>	<i>Price</i>
Communications Act of 1934, with amendments and index, revised to Sept. 1, 1948.....	\$0.20
Federal Communications Commission reports (bound volumes of decisions and orders exclusive of annual reports):	
Vol. 2, July 1935 to June 1936.....	2.00
Vol. 3, July 1936 to February 1937.....	2.00
Vol. 4, March 1937 to Nov. 15, 1937.....	1.50
Vol. 5, Nov. 16, 1937, to June 30, 1938.....	1.50
Vol. 6, July 1, 1938, to Feb. 28, 1939.....	1.50
Vol. 7, Mar. 1, 1939, to Feb. 29, 1940.....	1.50
Vol. 8, Mar. 1, 1940, to Aug. 1, 1941.....	1.50
Vol. 9, Aug. 1, 1941, to Apr. 1, 1943.....	1.25
Vol. 10, Apr. 2, 1943, to June 30, 1945.....	2.00
Vol. 11, July 1, 1945, to June 30, 1947.....	(1)
Annual reports of the Commission:	
First Annual Report—fiscal year 1935.....	.15
Twelfth Annual Report—fiscal year 1946.....	.20
Thirteenth Annual Report—fiscal year 1947.....	.25
Fourteenth Annual Report—fiscal year 1948.....	(1)
Statistics of the Communications industry:	
For the year 1939.....	.25
For the year 1940.....	.20
For the year 1942.....	.35
For the year 1943.....	.30
For the year 1944.....	.40
For the year 1945.....	.50
For the year 1946.....	.55
Report on Chain Broadcasting.....	.30
Report on Public Service Responsibility of Broadcast Licensees [Blue Book].....	.25
An ABC of the FCC.....	.05
Radio—a Public Primer.....	.10
An Economic Study of Standard Broadcasting.....	.40
Study Guide and Reference Material for Commercial Radio Operator Examinations.....	.25
Digest of Radio Regulations and Instructions for Restricted Radiotelephone Operators.....	.05
Standards of Good Engineering Practice:	
Concerning standard broadcast stations, revised to Oct. 30, 1947.....	1.00
Sec. 26, Sunrise and Sunset Table, revised to Apr. 20, 1948.....	.10
Concerning FM Broadcast Stations, revised to Jan. 9, 1946.....	.10
Concerning Television Broadcast Stations, revised to Dec. 19, 1945.....	.15

¹ In the process of printing—available at Government Printing Office at a later date.

Rules and regulations:

	<i>Price</i>
Pt. 1, Organization and Practice and Procedure, revised to Feb. 20, 1947-----	\$0.30
Pt. 2, General Rules and Regulations, revised to June 1, 1946-----	.10
Pt. 3, Radio Broadcast Services, revised to Jan. 16, 1948-----	.35
Pt. 4, Experimental and Auxiliary Broadcast Services, effective Sept. 10, 1946-----	(2)
Pt. 5, Experimental Radio Services, revised to Jan. 16, 1948-----	.10
Pt. 6, Fixed Public Radio Services, revised to Feb. 18, 1947-----	.05
Pt. 7, Coastal and Marine Relay Services, revised to Sept. 30, 1945-----	(2)
Pt. 8, Ship Service, revised to May 31, 1943-----	.15
Pt. 9, Aeronautical Services, revised to July 1, 1947-----	.10
Pt. 10, Emergency Radio Services, revised to Aug. 7, 1946-----	(2)
Pt. 11, Miscellaneous Radio Services, effective Jan. 1, 1939-----	.05
Pt. 12, Amateur Radio Service, revised to May 9, 1946-----	.10
Pt. 13, Commercial Radio Operators, revised to Jan. 30, 1948-----	.10
Pt. 14, Radio Stations in Alaska (other than amateur and broadcast), revised to Apr. 2, 1942-----	.05
Pt. 15, Rules Governing Restricted Radiation Devices, recodified July 21, 1948-----	(2)
Pt. 16, Railroad Radio Service, revised to Sept. 1, 1947-----	.05
Pt. 17, Utility Radio Service, effective Sept. 12, 1946-----	(2)
Pt. 18, Industrial, Scientific, and Medical Service, revised to Apr. 30, 1948-----	.10
Pt. 19, Citizens Radio Service, effective Dec. 1, 1947-----	(2)
Pt. 31-32, Uniform System of Accounts for Class A and Class B Telephone Companies—Units of Property Class A and Class B Telephone Companies, revised to Aug. 1, 1946-----	.30
Pt. 33, Uniform System of Accounts for Class C Telephone Companies, effective Jan. 1, 1939-----	.15
Pt. 34, Uniform System of Accounts for Radiotelegraph Carriers, effective Jan. 1, 1940-----	.25
Pt. 35, Uniform System of Accounts for Wire-telegraph and Ocean-cable Carriers, revised to Aug. 1, 1947-----	.45
Pt. 41, Telegraph and Telephone Franks, revised to Dec. 4, 1947-----	.05
Pt. 42, Preservation of Records, revised to May 27, 1943-----	.10
Pt. 43, Reports of Communication Common Carriers and Their Affiliates, revised to July 21, 1948-----	(2)
Pt. 51, Classification of Telephone Employees, effective July 25, 1944-----	.05
Pt. 52, Classification of Wire-telegraph Employees, effective July 11, 1944-----	.05
Pt. 61, Tariffs, Rules Governing the Construction, Filing and Posting of Schedules of Charges for Interstate and Foreign Communications Service, revised to Aug. 1, 1946-----	.10
Pt. 62, Applications Under Sec. 212 of the Act to Hold Interlocking Directorates, revised to May 23, 1944-----	.05
Pt. 63, Extension of Lines and Discontinuance of Service by Carriers, revised to Dec. 30, 1946-----	(2)
Pt. 64, Miscellaneous Rules Relating to Common Carriers, revised to Sept. 19, 1946-----	(2)

² Obtainable temporarily from the Federal Communications Commission, Washington 25, D. C., without charge.

3. TREATIES AND OTHER INTERNATIONAL AGREEMENTS

Federal laws, international treaties, conventions, regulations, arrangements and other agreements to which the United States was a party as of January 1, 1948, are listed below for reference. Unless otherwise indicated copies of these documents may be purchased from the Government Printing Office, Washington 25, D. C. (TS relates to Treaty Series, EAS to Executive Agreement Series, and TIAS to Treaties and Other International Act Series.)

Date	Series	Subject
1910		Ship Act of 1910 as amended in 1912 (Radiocommunication on the Great Lakes.)
1925	TS 724-A	Arrangement with Great Britain, Canada, and Newfoundland to prevent broadcast interference by ships.
1928-29	TS 767-A	Arrangement with Canada concerning private experimental communication.
1929	TS 777-A	Arrangement with Canada, Cuba, and Newfoundland relating to high-frequency assignments.
1929	TS 910	Safety of Life at Sea Convention (London).
1930	TS 921	Amendment to Regulation XIX of Annex 1 of Safety of Life at Sea Convention.
1932	TS 867	International Telecommunications Convention (Madrid).
1934	EAS 62	Arrangement with Canada concerning amateur and private experimental communication.
1934	EAS 66	Arrangement with Peru concerning amateur communication.
1934	EAS 79	Same, with Chile.
1937	EAS 109	Agreement with Canada concerning issuance of radio licenses.
1937	TS 962	North American Regional Broadcasting Agreement (Havana).
1937	TS 938	Inter-American Radio Communications Convention (First Inter-American Conference, Havana).
1938	TS 948	General Radio Regulations (Cairo revision, 1938) annexed to Telecommunications Convention (Madrid, 1932).
1938	EAS 142	Agreement with Canada concerning radiocommunications between Alaska and British Columbia.
1938	TS 949	Regional Radio Convention (Guatemala—in behalf of the Canal Zone).
1938	EAS 136	Arrangement with Canada concerning broadcasting.
1939	EAS 143	Arrangement with Canada concerning civil aeronautical services.
1940	EAS 231	Inter-American Radio communications Agreement (Second Inter-American Conference, Santiago, Chile).
1940	EAS 196	Agreement with Mexico concerning broadcasting.
1941	EAS 227	Supplementary North American Regional Broadcasting Agreement (Washington).
1945		Inter-American Telecommunications Convention (Third Inter-American Conference, Rio de Janeiro).
1945	TIAS 1518	Telecommunications agreement with certain governments of the British Commonwealth (Bermuda).
1946	TIAS 1553	North American Regional Broadcasting Interim Agreement (Modus Vivendi), Washington.
1946	TIAS 1527	Agreement with Union of Soviet Socialist Republics concerning commercial radio teletype communication channels.
1947	TIAS 1726	Agreement with Canada concerning FM broadcasting in 88 to 108 megacycles.
1947	TIAS 1670	Interim arrangement with Canada concerning mobile transmitters.
1947		International Telecommunication and Radio Conferences, Atlantic City. (Copies available through the American Radio Relay League, West Hartford 7, Conn.)
1947	TIAS 1652	Agreement with Great Britain concerning standardization of distance measuring equipment.
1947	TIAS 1676	Agreement with the United Nations concerning its headquarters' use of radio.

In addition, the United States is bound by certain treaties wherein some of the contracting countries did not become parties to subsequent agreements, thereby binding the United States to the original document. These include:

Date	Series	Subject
1912.....	TS 581.....	International Radiotelegraph Convention (London).
1927.....	TS 767.....	International Radiotelegraph Convention and General Regulations (Washington).
1932.....	TS 867.....	General Radio Regulations annexed to the International Telecommunications Convention (Madrid).
1937.....	EAS 200.....	Inter-American Arrangement concerning Radiocommunications and Annex (Havana).

There are also certain treaties, agreements, or arrangements primarily concerned with matters other than the use of radio but which affect the work of the Commission insofar as they involve communications. Among the most important of these are the following:

Date	Series	Subject
1944.....	TIAS 1591.....	International Civil Aviation Agreement, Chicago.
1946.....		ICAO Communication Division and Second Session, Montreal.
1946.....		Special Radio Technical Meeting, Montreal.
1947.....		ICAO Regional Air Navigation Meetings, Communications Committee, Final Reports.
1948.....		