

# BROADCAST TECHNOLOGY

JAN/FEB 1981



**A NEW OUTLOOK FOR  
SAULT'S CFYN/CHAS**

- **TELETEXT RECEPTION SYSTEMS—by Yvon Roy**
- **FM MULTIPATH DISTORTION—by Marvin Crouch**

# BROADCAST BEAT

by Phil Stone

**Richard Gallop**, who takes over as president of Cockfield Brown Inc., told *Report On Business* that satellite transmission, pay television and video discs—what he called “the understated revolution in new technology”—will create in the next two or three years a total revolution in the broadcast media, one that will rival the introduction of TV in the 50s . . . Two appointments at CFTO-TV are **Robin A. Fillingham** as vice-president and treasurer (he’s also v.p. and controller of Glen-Warren Productions Ltd.), and **Donald C. Ferguson**, long associated with the station in a sales capacity, as v.p., sales . . . **Rick Deegan** of the CRTC Broadcast Program Branch is the son of veteran CFRB air personality, **Bill Deegan** . . . The passing of **Bert Bond** was a sad occasion. One of the nicest people you could know, the veteran of CFTJ Cambridge, will be missed . . . And condolences to **Dan Iannuzzi** of CFMT-TV who lost his sister, Jenny . . . CKEY news executive **Howard English** is writing a book on Canadian news . . . Well-named department: CFRB’s **Bev Cudbird** lectures on “Weather and Bird Migration” . . .

The Toronto-based rumor that the radio broadcasting team covering Toronto *Blue Jays* games, **Tom Cheek** and **Early Wynn**, might have some alteration next year has been dispelled: the two have been signed for the 1981 season . . . The CKO-FM All-News chain has been sold to **Dr. Charles Allard**’s Allarco Broadcasting Co. of Edmonton. Guess is the price is about \$6 million for the seven stations involved. One would have to figure that new owners would want to make some changes in the format, which to date has been financially unprofitable. The CRTC did let Global change its licence terms when it was losing money, so perhaps . . . **Jeanne Caine**’s CHWO Oakville and CJMR Mississauga, with new transmitter facilities, are certainly sending stronger signals into the Toronto and Hamilton areas . . . If **John Lawrence**, the CRTC vice-chairman looks familiar to you, he’s the counsel who demonstrated such incisive knowledge of law when he worked for the CRTC and the

Privy Council . . . **Dave Armstrong** at Capital Broadcasting made **Walter Cowden**, previously program director, manager of operations at CKDA-AM and CFMS-FM Victoria . . . Group One Radio Limited, the radio reps, added another client in Edmonton’s newest commercial radio station, CKER . . . It is possible that captioned television programs for the deaf, to be viewed with special decoding, will be allowed in Canada anytime now. This would be under federal provisions permitting US-made decoders to be sold in this country and allowing Canadian broadcasters to use US-developed captioning signals. In the States, the decoder runs about 250 . . . At last report, Montrealers had more cars with FM radios than did Toronto—52% against 40% . . .

CHCH-TV made **Dick Beddoes**, the columnist and commentator, its full-time sports director, he left the *Globe and Mail* . . . A type of consortium has been formed by a group of 16 small-to-mid-sized regionally based ad agencies to challenge the large national Canadian agencies for national accounts. The group operates as the Canadian Association of Professional Advertising Agencies and has one member in each of the 16 largest markets in this country. The plan permits local agencies to pitch for national business through the expedient of using other agencies in the group to provide national coverage . . . Did you know this about television sitcoms (situation comedies)? At the start of each TV season the big US networks receive about 500 ideas. From them the average network will select roughly 80 to be scripted, at an average cost of \$25,000 each. That’s \$2 million spent on possibilities. As the winnowing process goes on, perhaps 16 out of the 80, or about 20% will be made into pilots. Of that group usually about four are ordered as series. How many of that four will become hits? Average is one . . .

CTV moved **Jack Fleischmann** to Ottawa from Toronto to be its parliamentary producer . . . **Steve Murphy** made the move from CJCH Halifax to CFBC Saint John . . . **Dick Gray**

left CHCH-TV to teach at Mohawk College . . . CJKL has a woman news director, **Linda Lahan**, who had been at CKOY . . . **Brian Perkin** in the CFRA newsroom was previously with **Wally Slatter's** operation in Guelph . . . **Brian Stone**, no relation, is working for **Bob Laine** at CFRW. He went there from CKLW . . . **Gord Atkinson**, g.m. at CFMO-FM lost **Bernie Boucher** to CKRA—FM where he's news director . . . Did you know that **Alan Thicke**, who replaced **Al Hamel** on CTV's afternoon talk show, really wanted to be a sports writer? . . . Our former Humber student, **Paul Jones**, who toiled for **Bill Hawkins** at CFOS, is now working in Fro-bisher Bay. Probably has "The Snuggies Hour" . . . If you've seen those "Coffee of the World Shops" around, it may interest you to know they are franchised by **Tim Snelgrove**, Ralph's son . . . Radio TV Reps opened a Calgary office. How that town is booming! . . . No doubt but that the cow-boys are currently the nowboys . . . Someone asked this corner if we ever heard what **Bill Stoeckel** is up to. **Andy McDermott** reports that Bill is in various franchise promotions . . . Former colleague, **John Spragge**, now v.p. of programming at CFRB, and **Pat Hurley**, v.p. and g.m. at CKMW, are the two broadcast directors on the Broadcast Executive Society's 1980-81 board. And a small question: aren't chief engineers broadcast execs? And, if agreed, how come there isn't at least one on the BES directorate? Or haven't the engineers bothered to become involved in an area where they certainly, one would think, ought to be . . .

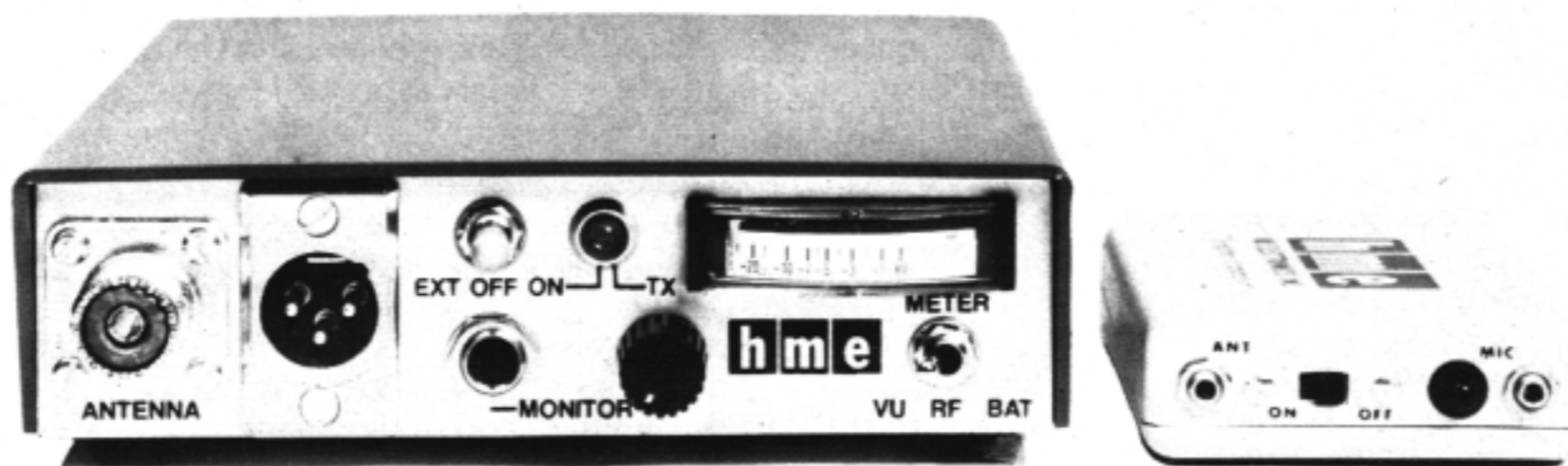
**Normand Beauchamp**, who was v.p., sales, is now v.p., Telemedia Communications Ltée and executive v.p. of Opex Communications Ltd., Telemedia's sales arm. As previously itemed, **Ron Hewat** is a v.p. at Opex, having moved there from CKFH. Ron is also active in the Hewpex Sports Network and is play-by-play man for the Toronto Maple Leaf hockey games on radio via Hewpex . . . **D. Lloyd Gartrell** put on several new hats: he's president and g.m. of Kel-

owna Cable TV Ltd., Penticton Cable TV Ltd., and of SOTV Holdings Ltd. Formerly v.p. and g.m., his new post reflects tribute to his pioneering the cable industry in the B.C. interior . . . The number of broadcasters achieving rank in the political arena was enhanced when **Ralph Klein**, former TV and radio reporter, was elected mayor of Calgary. In what was described as a stunning upset victory, Klein, who had never previously held elected office, ousted the incumbent **Ross Alger** . . . While many broadcasters are waiting in a hurry for the CRTC to approve Pay-TV, the Commission is giving its priority to broadcast service for under-served areas. Hearings on the subject were scheduled for February. According to the **Real Therrien** committee, which studied the extension of services to remote areas, an estimated 3.5 million Canadians have access to three or fewer channels and two million of these can only receive two, sometimes one, occasionally none . . .

Shakeups at CTV include the resignations of **John Scully** and **David Suder** from the news and public affairs department to go with CBC's *Newsmagazine*, and the departures of **Lionel Lumb**, producer of W5, and **Michael McCourt**, Washington correspondent. McCourt went to ABC to be their man in Johannesburg. He was replaced by **John McKenzie** who had been CTV's London reporter. That post is now held by **Clark Todd** who has been with NBC . . . A record \$15.6 million is to be paid by Carling O'Keefe Breweries Canada Ltd., for the TV rights to the 1981, 1982 and 1983 CFL seasons. Carling O'Keefe, which also happens to own the Toronto Argonauts, took the rights away from Labatt Breweries who had paid but \$6.6 million for 1978, 1979 and 1980. Toronto rumors are that the games, come next season, might be carried by Global TV . . . If, for any reason, your station wants to be in touch with the Stratford Festival, be advised that former treasurer, accountant **Gary Thomas**,



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is now the general manager . . . Shame on the Toronto columnist who sashayed sloppily over her semantics and called it the GLOBULAR Television Network . . . Speaking of Global, **Al Slaight** and wife Ada became grandparents via their daughter, Jan . . . Since we were last here in BT, the CRTC added two permanent commissioners: **John Grace**, who had been editor-in-chief of the gone to a fare-thee-well *Ottawa Journal*, and **James Robson**, research director to the Liberal opposition leader in Nova Scotia . . . The death of **Gilbert Templeton** must have brought back nostalgic memories to radio old-timers, as we recall his early day commercials that so often paid bills which would have otherwise been difficult to meet . . . It cost CTV \$25,000 to settle what was alleged to be an unjust dismissal. **Gary Ralph**, who had been a senior producer on the net's W5 program, got that much money in an out-of-court settlement. All a result of a controversial program on Chinese students in Canadian universities that raised a lot of hackles . . .

**Liz MacDonald** is back at Standard as part of the *Hour Toronto* crew . . . **Dodi Robb**, a grand veteran of the CBC succeeded **Keith Morrow** as director of the Corporation's Maritime services. Keith, as itemed earlier, is heading up the team developing the CBC's second English-language TV service in Toronto . . . **Roz Colley**, long traffic manager at CKFM and a staunch supporter of the Humber College radio course during our time there, is now with the station's sales department. She succeeded **Harry McIntyre** who is now one of the partners in CFPA Thunder Bay . . . **Maureen Fitzpatrick** took over the CKFM traffic desk . . . Veteran communications expert **George Semple** became president of Canadian Media Corporation . . . **Loen Hildebrandt**, once of McCann-Erickson, joined Standard Broadcast Sales . . . The appointment of **Roy Faibish** as vice-president, Europe, for Canadian Cablesystems Ltd., is apparently another master stroke by **Ted Rogers** . . . **Brian Wrobel**, the CFRB overnight newsmen, is now at Fanshawe College teaching broadcast journalism. **Dave McClearly** came down from CFOS to replace him . . . And at 'RB, **Bruce Glover**, who had been with Rogers, is on the sales force . . .

From an early radio job at **Dick Buchanan's** CKPC to a role as a major commercial announcer in the States: that's the story told in *Today* magazine of **Ron Morey**. You get the voice, you got the choice . . . **Jack Miller** did a big job defining the 18 signals (radio) that come into Toronto for an edition of the *Toronto Star*. Jack quoted an American observer who said of Canadian radio: "I think you have a fuller radio service. But this regulatory involvement in programming worries me. I guess," he said, "everything has a price." . . . Canadian Cablesystems appointed three Premier Communications figures to its board of directors: **Syd Welsh**, founder and chairman; **George A. Fierheller**, Premier's president and c.e.o., and **W. Garth Pinter**, co-founder and vice-chairman. CCL also named the lovely TV personality, **Carole Taylor**, whom we recall from her teens when she won the Miss United Appeal contest and this writer was one of, excuse the modesty, the perceptive judges . . . **Ted Rogers**, the major domo of Canadian Cablesystems, figures it will begin offering Pay-TV by roughly October of 1981 and is meanwhile working to increase its penetration of U.S. selected markets, a move enhanced by the fact that unlike Canada, the U.S. has many areas still not covered by cable . . . When **Bob Holiday** was upped to v.p., news, by CFTR, one of our former students from Humber College, **Evelyn Macko**, moved into his air slots . . . **Joe Crysdale**, whose name brings back a lot of early radio memories, will be back next summer for the fourth year, broadcasting the play-by-play of Toronto Maple Leafs of the Ontario Intercounty Leagues for CJMR . . . **Mac McCurdy**, president of Standard Broadcasting Corp. Ltd., and a man always conscious of his community responsibilities, has reidentified that commend-

able bent by taking on the presidency of the Clarke Institute of Psychiatry . . .

From Cable Communiqué, the informative news bulletin of the CCTA, we learned that **Larry D. Biswanger**, president of Alberta Broadcasting Corp., is president of the Cable Television Association of Alberta (CTAA), succeeding **Robert J. McIntyre** of Capital Cable TV, Edmonton . . . For your calendar: Canada's version of the Oscar, the Etrogs, will be awarded on March 12, 1981, at Toronto's Royal Alexandra Theatre . . . The *Globe and Mail* waited a most decent time after **Blaik Kirby's** untimely death to name a new television critic for the paper. He is **Rick Groen** who came to The *Globe* a year ago and this 32-year-old said of TV when appointed: "It's fascinating because it embraces so many opposites. At one extreme it's a valuable esthetic and informational medium, at the other, it's a household appliance as banal as a toaster. It's a soporific for some, a companion for others, and for all of us a sort of frosted window on the world. In markets with as many channels as Toronto, it's also a relentlessly ironic medium, speaking out of a dozen different faces at once. Everyone from Willie Mays to Willie Shakespeare all talking simultaneously, pouring out thousands of words an hour, millions a day." . . .

**Anne Arsenault**, who used to shine on the TV screen when with CITY-TV, phoned to proudly, and justifiably so, announce that she and husband **John Dimon** had become the parents of a lovely baby girl, Julia. Dimon is acting head of CBC-TV variety, and Anne, recently information director for the Better Business Bureau, is now operating her own publicity consultant business, one highly recommended to anyone requiring such services . . . The China News Agency says that the government will increase the total of TV sets in the nation by two to three million sets a year. As of now, there are but five million sets for a population of nearly a billion . . . **Gary Dunford** in the *Toronto Sun* took a shot at the government broadcasting official who, upon learning that MOR meant middle-of-the road, exclaimed, "I always thought it meant music-on-records!" . . . **Peter Simpson**, president of Sitcom Limited, announced the appointment of pretty **Helga Stephenson** as v.p. Her responsibilities include media buying for advertising clients . . . Now that we're off into a new year, may I wish you the traditional wish of my Scottish ancestors in an Anglicized update—"May the best you've ever had be the worst you'll ever have!"



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# CCBA Engineering Newsletter

by Dave Gillard

## "Who's Where" Dep't . . .

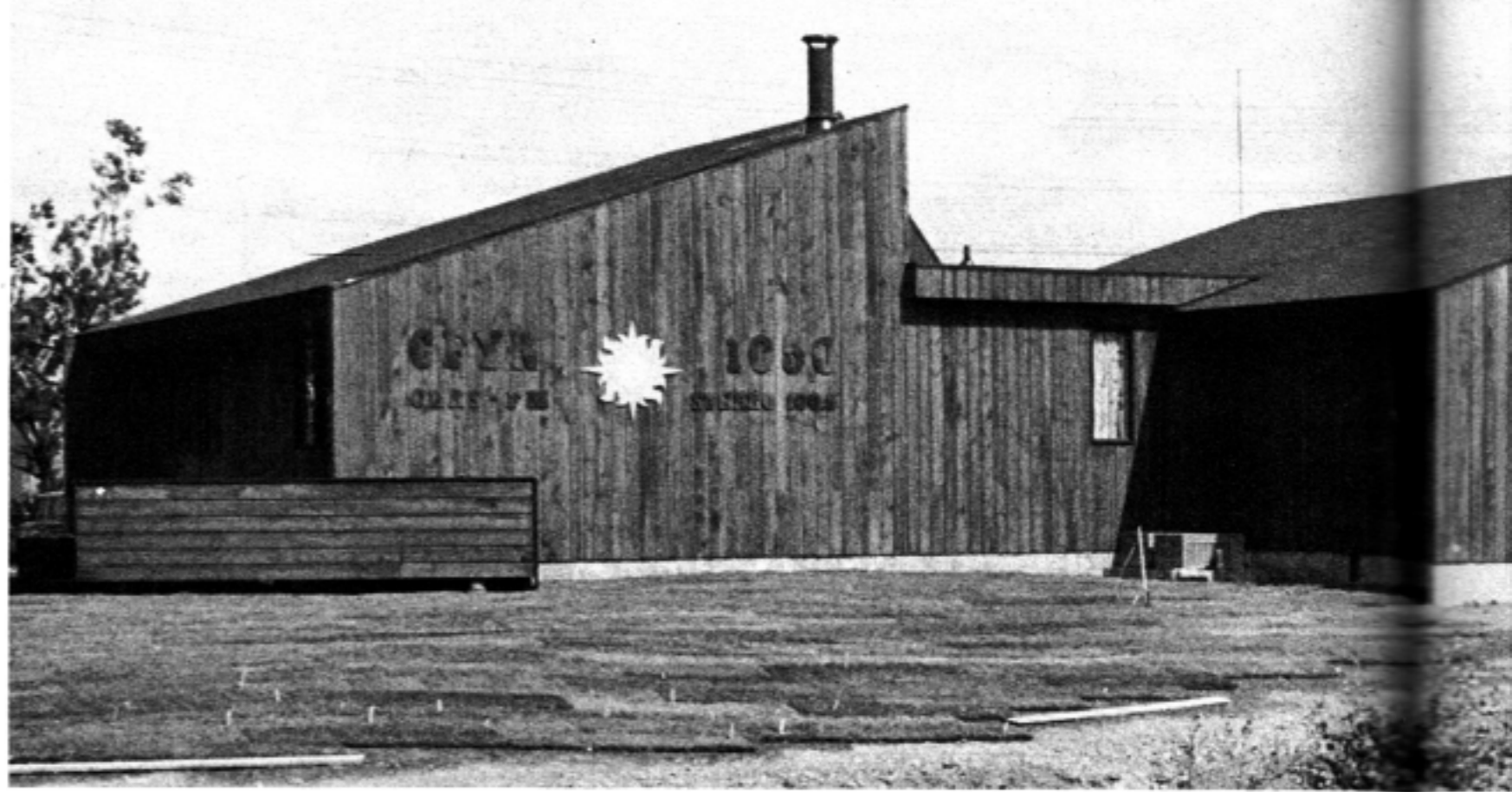
Larry Keats, formerly of CKOC in Hamilton, moves to CHUM Toronto, under Bruce Carnegie . . . Steve Martak moves along from CHUM to work at MTV Channel 47 in the engineering department . . . Ron Heffler from CKSO in Sudbury took over as director of engineering at CFGM/Q107 Toronto . . . David Haydu leaves as studio tech from Q107 for an announcing position at CFNY in Brampton . . . Kirk Stewart from CHIN Toronto is the new director of engineering for CJJD in Hamilton . . . and we hear that Trevor Joice has moved up to director of engineering at CHIN, to allow v.p. Paul Hunter to be more active with PWH Electronics.

Congratulations are due to Warren (CKTB) and Danielle Parker on the arrival of a baby girl, Leann, on November 27th . . . also from St. Catharines comes word that CHSC has its new 10 kw array in operation. CHOW Welland should also have its 10 kw array on-air shortly.

David Strachan of Comad reports that Charlie Tryon at CFBK Huntsville is installing a new McMartin 1 kw AM transmitter. In Quebec, Radio Pontiac (CHIP-FM) plans to put three community stations on the air in March, using McMartin transmitters: Fort Coulonge (3,000 watts ERP on 101.7) will use a BF 3.5M with 3-bay Comark antenna on a Wind Turbine tower; Chapeau (150 w, 93.5) a BFM-100 with 4-bay Phelps Dodge antenna; Rapides-des-Joachims (35 w, 94.3) a BFM-50 with 3-bay Phelps-Dodge antenna. The latter two locations will pick up the signal from Fort Coulonge by means of a McMartin frequency-controlled receiver. STL and remote control equipment is also being supplied by Comad.

David A. Gillard is publicity chairman for the CCBA Engineering section and director of engineering, CFOS/CFPS Radio. Information for the Newsletter should be addressed c/o CFOS, 270-9th Street East, Owen Sound, Ontario N4K 1N7, or telephone (519) 376-2030.

## CONTEMPORARY DESIGN FOR CFYN/CHAS COMPLEX



New building for CFYN-1050 and CHAS-FM 100.5 in Sault Ste. Marie, Ontario, is of frame construction, heavily insulated. Facing due south, its roof is at a 54 degree angle for adaptation to solar energy panels. Only one window faces north/west, making building warmer in winter, cooler in summer. On one-acre site in geographical heart of city, complex was designed by Gerry Porter.

## A Moving Experience

It took 54 straight, non-stop, uninterrupted, continuous hours of cutting, wiring, soldering, grounding, heating, shrinking, vacuuming and polishing to put CFYN and CHAS-FM on the air from a modern new complex—all with only one foul-up of less than two minutes duration.

Moving from old studios, situated on two floors above a downtown furniture store, to specially-designed, single floor facilities on top of the hill overlooking the city, was no small chore, but thorough planning and a capable staff minimized the difficulties.

John Gribbon, now with CKSL in London, prepared the broadcast module of the new building, with under-floor conduit, and wiring troughs strapped to the underside of the ceiling of the basement. Over 8,000 feet of Belden two-conductor, grounded, shielded cable was easily fished from

the studios to the equipment room—plus every conceivable point in-between. The studio block is 49' x 20', so it takes a few strands back and forth to account for the mile-and-a-half plus of wiring.

For the move, CFYN/CHAS-FM closed down its production studio at 5 pm on a Friday, and simply cut every wire from the back of every board, turntable, reel-to-reel, cart machine, equalizer and compressor. The loose ends were systematically removed, the terminals flushed and cleaned, and appropriately labelled to receive the new connections. At midnight, the production studio in the new building, was wired in, tested, and ready to operate as either a mono or stereo back-up studio for AM or FM master control. The all-night announcer reported to the new studio, and as the evening man "signed-off" from the old location, the first broadcast began from the new complex.

The new studio, FM Master control, was similarly stripped down and re-located. About 9 am the next morning, we were in business with two operating studios, and by early evening, the AM control room had been transplanted. The talk studio was next, and finally the news room. The remarkable thing about the whole operation was that it took place in the middle of howling, miserably cold February weather.



While the technical construction was underway in the broadcast module, the administration module was a beehive of filing, finding, fitting, fussing, pulling, pushing, polishing, piling, and—voila!—by Sunday afternoon, it was “gung ho” for Monday morning business. Meanwhile, back in the control rooms, lines required balancing, equipment modes needed interlinking, off-air lights, alarms, remote controls, clock, timers and outboard equipment all required connections into the master plan. As all of this wiring took place, the technical team had to carefully catalogue their accomplishments by committing each connection to schematic posterity.

The mess left behind in the old rented studios, was absolutely incredible, but the finished configuration of the new quarters was hailed as the miracle of technology. Four dedicated engineers, working in harmony for 54 hours straight without so much as a frayed nerve or a raised voice, epitomized the profession’s highest standards. CKTB’s Warren Parker, CKSL’s John Gribbon, former CJIC engineer Frank Parsons, and technical student Grant Butcher worked together like a Vegas



Staff entrance at rear. Smiling CFYN/CHAS-FM crew is obviously happy with their new “home”. (Photos by Wishon Photography, Sault Ste. Marie, Ont.)

chorus line. Ray Rylatt of CKCY dropped in as well to offer his assistance.

The key outside factor, in any major move, is the Bell Canada people. Their technicians worked in unison with our team, and labored long into the night to balance and equalize lines, establish criteria for feeds to the two transmitter sites, and generally accomplish the final stages of relocation. Were it not for the proficiency and co-operation of the Bell staff, the whole weekend could have been disastrous. We now have 100 pairs of lines coming into the building, allowing about 40 spare lines for future expansion.

The only minor hitch in the whole operation, occurred on Sunday morning, at 9 am. AM was to carry the CBC’s *Morningside*, while FM was about to air a Ukrainian Church service. We were working on the final touches of some circuits in AM and heard the CBC broadcast begin. Seconds later, the ‘phones were ablaze with miffed listeners expecting CBC on AM. We explained that, yes, it was on, and we were standing there in the midst of the AM control room, hearing it on the monitors. The callers insisted, no . . . AM (CFYN) had someone

preaching to them in another language, and it certainly wasn’t CBC! An engineer raced to the basement and switched the interface connections between AM and FM, realizing that what was to have been the FM studio on the outgoing broadcast had been wired to receive CBC on the incoming system, whereas the AM studio had been connected to the FM program feed.

After being on one’s feet for 48 hours, the slightest humor becomes a roaring tide of laughter and hysteria. We never realized wiring, soldering, pulling, labelling, placing, planting and cleaning could be outrageously hilarious!

Finally, at 1 pm Monday, a huge steak and eggs brunch culminated the effort—surely one of the most challenging endeavors any station engineer, manager, owner or staff member could ever live through. The results have been more than rewarding—in soaring staff morale, increased respect in the marketplace, higher profile and the increased efficiency of working in a building designed by and for broadcasters.

(Story courtesy of Russ Hilderley and staff, CHAS/CFYN-FM Sault Ste. Marie, Ont.)



View of reception area from entrance to broadcast module. “Living room” decor is tasteful, colorful; open ceiling has skylights, rough-hewn beams.

CJMX-FM Stereo in Sudbury, Ontario, went on the air October 13, 1980.

Program manager Ms. Terry Hart reports that listener response to the station has been "fantastic", with letters and telephone calls from numerous communities, including North Bay, New Liskeard, Temagami, Espanola, Gore Bay, Elliot Lake and Sturgeon Falls.

Broadcasting a beautiful music format, CJMX operates on 105.3 MHz with a power of 100,000 watts using horizontal and vertical polarization. It is Sudbury's fourth FM station, joining CIGM and the CBC's CBCS (English) and CBON (French).

The new FM station is the most recent achievement in the 34-year history of Sudbury Broadcasting Co. Ltd., which operates AM stations CHNO and CFBR.

Sudbury Broadcasting was formed in 1946 by a group of Sudbury residents who applied for a licence for a one kilowatt station. The group included Senator J.R. Hurtubise, president; J.M. Cooper, secretary; A.J. Samson, vice-president; F. Baxter Ricard, G.M. Miller and Leo Gauthier, directors. The chief engineer and manager was Alex Robinson, who supervised construction of the station. CHNO (Northern Ontario) went on the air June 24, 1947, on 1440 kHz. Prior to this date, the only radio station in the nickle capital had been CKSO, established in 1935.

The first bilingual station in Ontario, CHNO divided its 16-hour daily schedule into eight time blocks—four in English and four in French. Rene Riel, later commercial manager, was director of French-language programming. CBC network shows were carried in both French, from Radio-Canada, and English from the Dominion network.

In 1954, Baxter Ricard became president and general manager of the company, with his wife Alma as secretary-treasurer. CHNO's frequency was changed to 900 kHz.

Three years later, on December 7, 1957, French-language CFBR went on the air, operating daytime only on 550 kHz, and CHNO broadcast in English only. The two stations exchanged frequencies in January, 1970, allowing CFBR to operate full-time and increase power from 1 to 10 kw, on 900. In the fall of 1978, CHNO increased power to 10 kw day and night on 550. A further

## CJMX-FM LATEST MILESTONE FOR SUDBURY BROADCASTING



*Production control room includes Ward-Beck board, three Studer Revox tape machines (two B67s, one B77), two Technics turntables, Ampro and ITC cart machines and Advent speakers. Equipment was supplied by Caldwell and installed by CJMX-FM technical director Henry Albert, assisted by Alan Aysto. (Photos by Tramontin Photography, Sudbury.)*



*CJMX-FM master control is equipped with Ward-Beck board, three Studer Revox B77 stereo tape machines, two Technics turntables, an Ampro three-cart machine and Shure microphone. Station uses CCA 20 kw transmitter, complete with Optimod, and 12-bay antenna is mounted on Mid-Canada Communications tower, shared by CICI-TV and CIGM-FM.*

increase to 50 kw is now planned.

Technical director Henry Albert notes that both stations shared the same antenna array in 1957, and still do so today, despite the increased complexity of their directional patterns. CHNO and CFBR are believed to be the first private AM directional stations in Canada to be co-sited.

Another recent milestone in the history of Sudbury Broadcasting was its

move, in November 1979, to the former King George School on Victoria Avenue. This provided additional space to accommodate CJMX-FM.

To cap his 34 years of involvement with Sudbury Broadcasting, F. Baxter Ricard was named recipient of the Howard Caine award at this year's CCBA convention, for his service to the community. (See convention report in this issue.)

will eventually see sports and other shows in 3D, "capable of portraying objects coming out of the screen to within several inches of the viewers' eyes and going deep back into the television screen."

### **CJUS-FM SASKATOON OPENS NEW STUDIOS**

The University of Saskatchewan station, CJUS-FM, marked its 15th anniversary on December 9 with the official opening of its new studios.

Located in the Audio Visual Centre, Education Building, the facilities were designed and built by Al Pippin, director of engineering. They provide three times more space than the old CJUS studios, and include four control rooms and three studios (two, four, and 8-track). More than 500 separate audio circuits were installed.

Station manager Gordon Walburn describes the new facilities as technically superior, with increased production capacity and versatility. Equipment has been upgraded, and the station is now integrated with television facilities of the A-V division. Non-commercial, CJUS-FM operates 118 hours weekly on 89.7 MHz.

### **50 YEARS IN RADIO, PARKER SELLS CFPA**

Ralph H. Parker has retired from broadcasting with the recent sale of CFPA Thunder Bay to Leader Broadcasting Co. Leader's president is Sol Laskin, a former mayor, and Harry McIntyre, formerly of CKFM Toronto, is manager.

Ralph Parker started in broadcasting in the late 1920s at Midland, Ontario. In 1931, the Midland station, CKPR, was purchased by Patterson Steamships and moved to Fort William. A self-taught engineer, Parker went with CKPR and remained to establish his own station, CFPA Port Arthur, in 1944. He also built the area's first FM and TV outlets. Active in programming and announcing, he broadcast Royal visits locally and for networks since 1939.

Ralph plans to keep active in radio with his home amateur station VE3HU, on the 20-meter band.

### **LIGHTING WORKSHOP**

A television lighting workshop is to be held January 30 to February 1 at the new studios of KLVX Las Vegas, sponsored by the Public Telecommunications Institute of the National Association of Educational Broadcasters.

The instructor will be David M. Clark, lighting director for 15 years with Imero Fiorentino Associates in

New York. Sessions will cover new lighting and staging techniques in both studio and remote situations, using actual studio set-ups, on-camera demonstrations, and slide/cassette presentations. Fee is \$375 (non-members); information from NAEB, 1346 Connecticut Ave. NW, Washington, D.C. 20036, telephone (202) 785-1100.

### **FIRE AT MGM GRAND FORCES NAB MOVES**

The National Association of Broadcasters is using additional space in a number of Las Vegas hotels to compensate for the closing of the MGM Grand. The hotel will not re-open until the end of 1981, as a result of the disastrous fire which claimed 84 lives. Television headquarters, formerly at the Grand, will be spread to three nearby hotels, the Dunes, Caesar's Palace and Aladdin.

The Canadian contingent's block of rooms has been moved from the Dunes to the Hacienda hotel at the south end of Las Vegas Blvd.

### **TELIDON SELECTED AS U.N. STANDARD**

The United Nations' International Telegraph and Telephone Consulta-

tive Committee has selected Canada's Telidon as a world standard for two-way television (Videotex) systems. The endorsement means that the Canadian system will be recognized equally with the British (Prestel) and French (Antiope) systems.

### **IEEE MARKS 25 YEARS**

The 1981 International Electrical, Electronics Conference and Exposition will be held October 5-7 at Exhibition Place, Toronto.

Sponsored by the Canadian region of IEEE, the biennial conference is celebrating its 25th anniversary this year. Over 100 technical papers will be presented, with particular emphasis on telecommunications. Chairman of the conference is L. Claude Simmonds of A. C. Simmonds & Sons Ltd.

### **U.S. PADA FORMED**

The Professional Audio Dealers Association has been formed in the United States, with headquarters in Los Angeles. Initially, membership is being limited to dealers whose sales exceed \$1 million a year. Acting as temporary national chairman is Dave Kelsey of Filmways Audio Group, Hollywood.



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# FM MULTIPATH DISTORTION

The mechanism behind it, and how to use it to site a station

by Marvin B. Crouch, P.Eng.

In FM broadcasting there are a number of problems all lumped under the general title of "Multipath".

In previous articles, I have explained that standing field pattern problems result from rf signal additions and cancellations. These field strength problems—which produce the picket fence phenomenon when driving through them—are the result of short delays, less than 1 km.

This paper deals with a much more severe difficulty, where the audio signal is highly distorted and even unintelligible. This problem is a characteristic of long delays, more than 1 km.

When an unmodulated carrier fre-

quency is split and arrives at a point at different times, the only effect is to either strengthen or weaken the main signal. No non-linear distortion takes place.

It is a much different case when an FM modulated signal is split and arrives at a point at different times, because we no longer have the same frequency but rather two different frequencies at any one instant.

One can think of multipath interference as similar to sweeping a coax: if the fault is close to you, a wide sweep is necessary; if the fault is distant, a narrow sweep is all you need to see a standing wave cycle. At the extreme of

$\pm 75$  KHz of deviation or 150 KHz, one cycle of beat note in each cycle of deviation would represent a path differential  $300 \div 0.15$  or 2 km, which is  $2000 \div 300$  or  $6.67 \mu\text{S}$ .

At greater distances one could have several cycles of a beat note. For instance if 10 AM beat cycles occurred in  $\pm 75$  KHz of deviation, the differential path length would be 20 km. Figure 1 shows this in graph form where to the left of the curve we have a beat note lower in rate than the deviation and to the right of the curve we have multiple cycles of beat in each cycle of deviation. This beat note phenomenon is a factor of deviation, not of the rate of deviation. No matter what modulating frequency we have, the beat note is constant with all rates of deviation and is caused only by the path length difference. If we modulate at 100 Hz rate or if we modulate at 10 KHz rate, the beat note is a function of deviation and to the right of the line in Figure 1 will be at some fixed multiple of all FM modulating frequencies.

Most papers on this subject speak of a high harmonic content in multipath distortion. From the foregoing it is easy to see that this multiple of the FM rate accounts for this harmonic content. It also accounts for the fact that broader deviating signals are more susceptible to multipath distortion than narrow deviating signals. This harmonic distortion does not take place until the AM rate exceeds the FM rate.

The AM in itself is not a distorting phenomenon, but it causes additional unwanted FM-ing when the vectors are added. The amount of distortion is directly proportional to the ratio of the main and reflected signals. Fortunately, because of free space attenuation, the further away the reflecting surface is the less likely it is to have distorting influence because of its diminishing strength. However, there are circumstances where the main signal can also be attenuated. The favorable high ratio is lost in shadowed main signal areas.

There is a new portable measurement instrument on the market that displays this AM beat phenomenon against the deviation on a CRT. The Hirschmann company of Austria makes it and it is called the RPM 2000. Some years ago, commercial radio manufacturers included a similar indicator in their console radios. The Kenwood, the Marantz and Sequera FM tuners were very useful for positioning a fixed receiving antenna to be free of multipath. Now, with a portable instrument to display this pattern, it is possible to assess a prospective transmitting site if a small lower power transmitter can be temporarily set up.

The depth of AM modulation that is tolerable is approximately 5%/KHz for

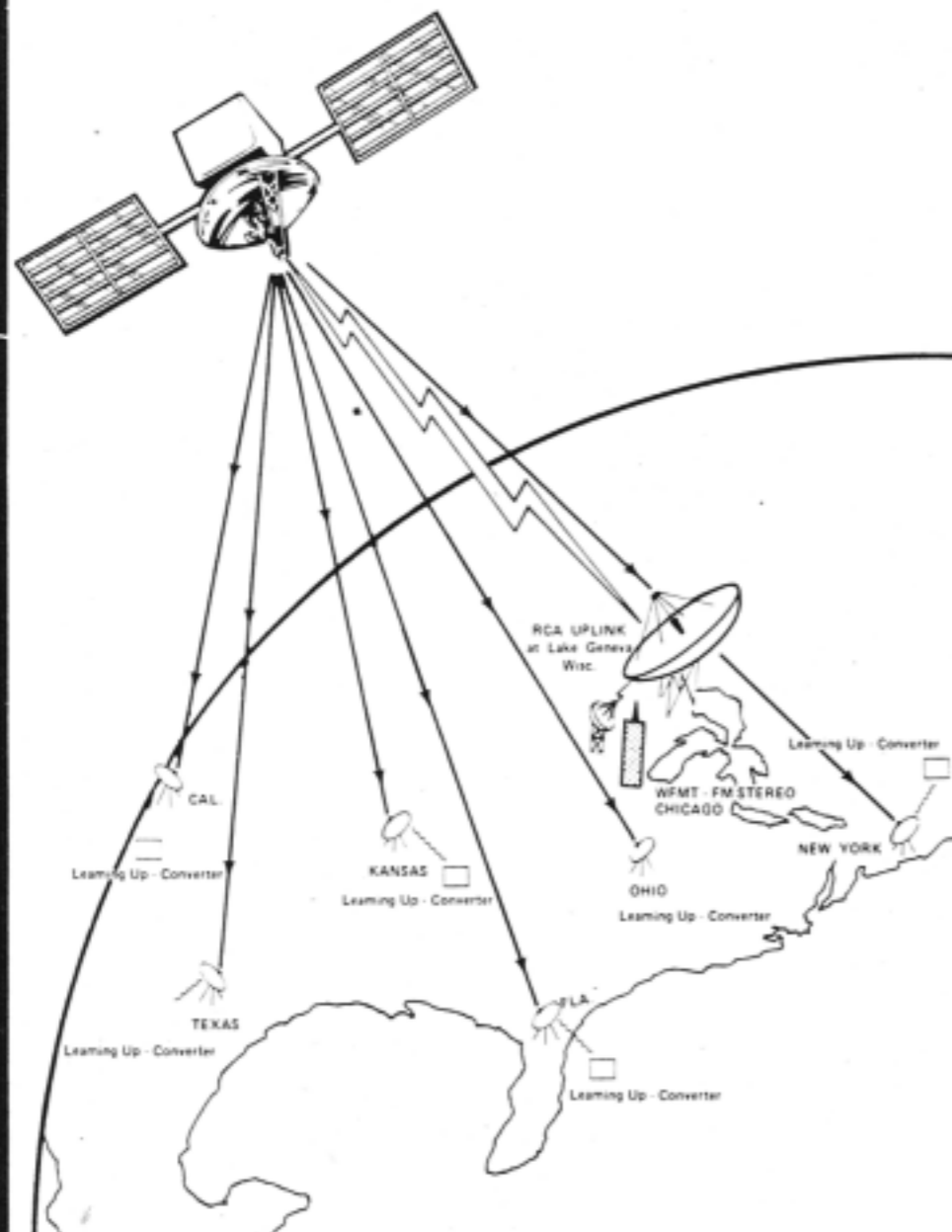
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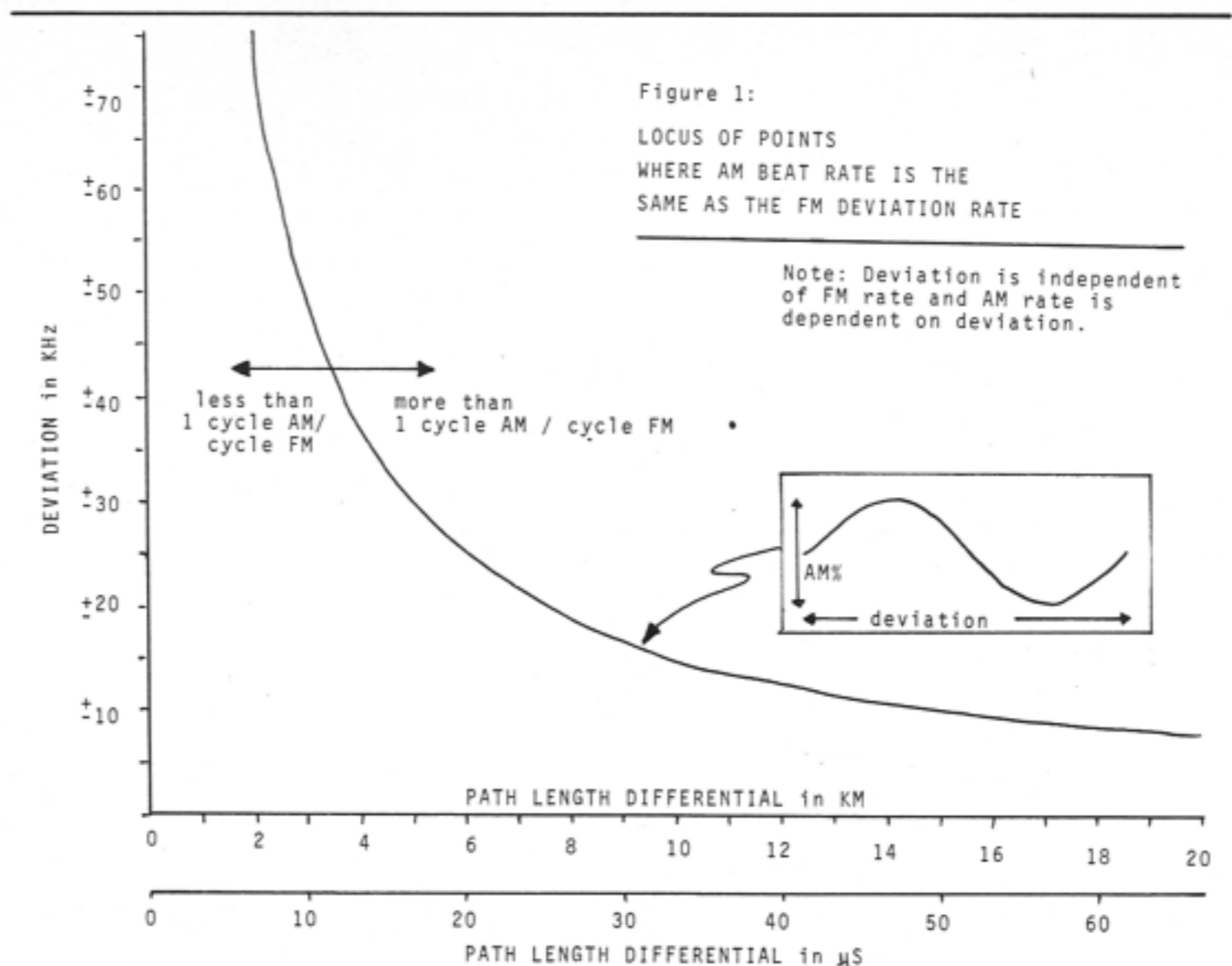
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monaural broadcasting, but only 2%/KHz for stereo broadcasting because of the fact that the harmonics of low frequencies fall in the L-R part of the band. The Hirschmann RPM 2000 instrument, with its display of deviation horizontally and AM interference vertically, allows measurement of three very useful parameters:

1. The depth of AM modulation reveals the relative strengths (*distortion*).
2. The number of beat note cycles per unit of deviation is the differential path length (*distance*).
3. With movement of a measurement omni antenna (such as whip on a vehicle), the beat note will progress to the left when approaching the reflection and to the right when moving away from the reflection. One need move only one half wave length, or 1.5 meters, to reverse the phase of the beat note (*direction*).

These three items of information allow the engineer to determine whether or not the area of coverage is going to suffer from multipath distortion, and locate the source of reflection before his major investment. One can even try experimenting with a more directional transmitting antenna so as to reduce the illumination of the reflection source.

The instrument is also useful in CATV work. In cable TV, I have no-



ticed that many cable operators would do well to use more directional receiving antennas to prevent multipath distortion on the FM signals they receive and deliver via cable.

In summary, we could say that the state of the FM broadcasting art is advancing because it is now possible to test for multipath before investing.

Fixed receiving situations can be optimized—and mobile receiving situations can be helped—by tailoring transmitting antenna patterns to avoid stimulating reflecting terrain.

Marvin B. Crouch, P.Eng., is general manager of Tennaplex Systems Ltd., Ottawa, Ontario.

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# appointments

● Broadcast Electronics, Inc.—**Robert R. Weirather**, formerly with Harris Corp., appointed vice-president, engineering, in Quincy, IL.

● CKSL Radio, London, Ontario—**Gordon Hume** appointed general manager, effective December 1, 1980. Active in the Broadcast Promotion As-

sociation, he was previously with CKPC Brantford, CHYM/CKGL-FM Kitchener, CJJD Hamilton and Rogers Broadcasting.

● Camartron Communications Inc., Toronto—**Eric A. Grant** named sales manager; 15 years in industry includes CTV, CFTO, and sales experience with several suppliers.

● CRTC, Ottawa—new full-time commissioners are **John Grace**, formerly with the *Ottawa Journal*, and **James Robson** of Halifax. **Richard De Stefano**, a communications instructor at Cambrian College in Sudbury was made a part-time commissioner.

● Communications Research Advisory Board (CRAB)—**T. Ran Ide**, former chairman of TV Ontario, succeeds Alphonse Ouimet as chairman.

● Department of Communications—**John Gilbert** to director of industry services; his successor is **Gary Brooks**, who returns to DOC from International Frequency Registration Board (IFRB) in Geneva. Joining Montreal office as broadcasting engineer is **Buu Phuong Vu**, formerly with Radio-Canada.

● Fernsech Inc.—**Howard McClure**, formerly with Lenco Inc., appointed director of product management in Salt Lake City.

● Filmways Audio Group, Hollywood, CA—**Linda Feldman** named marketing director; **Rick Benson**, formerly with Tascam, becomes pro audio sales service manager.

● JVC—**Logan Enright** promoted to West Coast regional sales manager.

● LeBlanc & Royle Communications Towers Ltd.—**Jim Porterfield** appointed sales rep for southwestern Ontario.

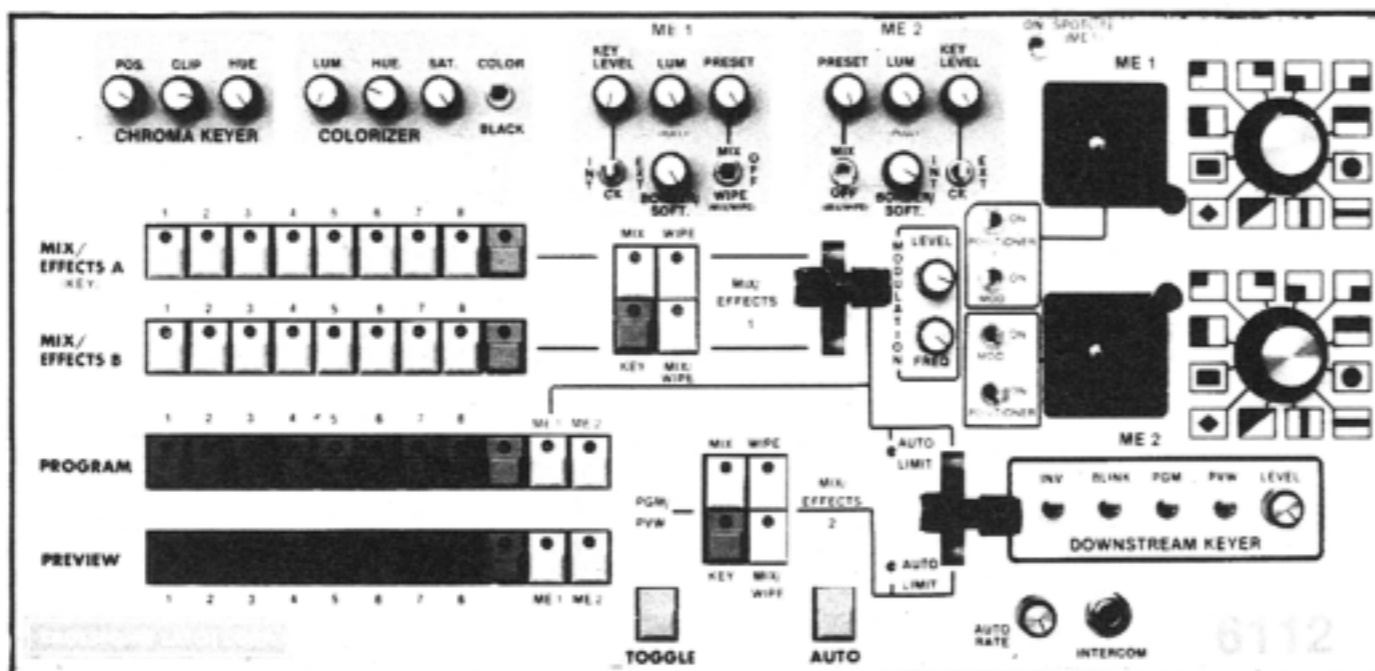
● Marcom—**Don & Gerri Bowdish** will staff new Marcom office at 21243 Ventura Blvd., Suite 145, Woodland Hills, CA 91364, telephone (213) 703-0381.

● Meritron Ltd.—**John Forrest**, pre-

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viously with Tele-Tech, has joined Meritron, Toronto.

● NAVAC—new officers of National Audio Visual Association of Canada are **Tony Cook**, chairman; **Douglas Elphick**, president; **Oscar Fiteni**, v.p.; **Peter Dixon**, executive v.p.; **Bruce Paxton**, secretary; and **Bill Carr**, treasurer. Regional directors are **Don MacKay**, Halifax; **Serge Ruhlmann**, Montreal; **Kirk Lidbetter**, Ottawa; and **Bob Gibson**, Calgary.

● National Film Board of Canada—**Roland Ladouceur** promoted to director of new NFB office in Los Angeles.

● NRBA, Washington, DC—**Lise Friede** promoted to vice-president.

● Norfolk Communications, Toronto—TV production firm has named three vice-presidents: **Rob Parker**, programming; **Mark Moore**, finance; and **Paul Kent**, production.

● Ryerson Polytechnical Institute, Toronto—**Dr. Ron Keast**, previously general manager at TVOntario, appointed to three-year term as chairman of Radio & Television Arts department, succeeding Robert Gardiner.

● Scientific-Atlanta, Inc.—**Jim Bacon** promoted to g.m. of new coaxial cable manufacturing division in Phoenix,

Arizona. Appointed regional sales reps, cable division, are **J. Robert Bird**, Englewood, Colorado; **Harold W. Mathews**, Kansas City; and **Stan W. Sands**, Richardson, TX.

● TVOntario—**Gene Lawrence** named general manager, educational media division, succeeding Ron Keast. Lawrence was with CBC for 16 years, and for the past eight years was production director of British Columbia educational media centre in Vancouver.

● Times Fiber Communications—**Clarke V. Greene** to systems engineer; **George N. Kringel** to manager of marketing services, CATV group.



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# crtc

## HEARINGS

### VANCOUVER—NOV. 25

Applications heard included:

- Whistler Communications Corp., for FM at Whistler, B.C. (134 watts, 102.1 MHz), with rebroadcasters at Garibaldi (14 w, 106.1) and Pemberton (14 w, 98.1).
- Mountain 99 Broadcasting Ltd., for FM at Squamish, B.C. (2,400 watts, 104.9 MHz), with rebroadcasters at Whistler (380 w, 100.1) and Pemberton (46.4, 104.5).
- Panorama Cable Systems Ltd., for a new cable TV system at Invermere, B.C.
- CHCH-TV Hamilton, for a network consisting of CHCH, CBET Windsor, CKND-TV Winnipeg, CITV-TV Edmonton and CHAN-TV Vancouver, to carry Toronto Maple Leafs hockey.
- CBC, for a rebroadcaster of CBON-FM Sudbury at Kapuskasing, Ont., 40 w on 1370 kHz.

### REGINA—DEC. 9

#### CABLE TV, NEW FM's HIGHLIGHT HEARING

In response to a Dec. 7, 1979, call for applications to provide cable TV service at locations within the A and B. contours of CTV affiliates in Saskatchewan, 109 applications for 47 locations were received and scheduled for hearing on December 9 at the Regina Inn.

Applicants (with number of locations in brackets) included:

- Cable Swift Current Community Co-op (4)
- Prairie Co-Ax Ltd. (14)
- George S. Skinner (28)
- Battlefords Community Cablevision
- Abraham Berday (2)
- Stan Horner (Swift Current)


Swift Current Cablevision (1)  
Swift Current Telecasting (1)  
Eastern Sask. Community Media Co-op (2)  
North Eastern Cablevision (4)  
Yorkton-Melville Telecable (4)

Meanwhile, the CRTC called for further applications for another 15 Saskatchewan communities not located within the A and B

contours of CTV affiliates. Deadline was December 15, 1980, with a hearing to take place in the spring.

Applications for FM stations include:

- Saskatoon—CFQC (100 kw on 95.1); Gerald G. Fraser (20 kw on 106.7); and CKOM (100 kw on 102.1 MHz).



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● Regina—CKCK and CJME, both for 100 kw on 98.9 MHz. Also at Regina, Harvard Developments Ltd., owner of CKCK-TV, has applied to purchase CKRM and CFMQ-FM from Buffalo Broadcasting.

● Prince Albert—CKBI, for 100 kw on 99.1.

● Selkirk, Man.—Denis L. Cloutier, for 7 kw on 92.9.

● Gillam and Jenpeg, Man.—Garry H. Shapera, for rebroadcasters of CJOB Winnipeg, 89 w on 94.1 at Gillam and 460 w on 96.1 at Jenpeg.

● CBC—for FM rebroadcasters at Cumberland House and Pelican Narrows, Sask., Flin Flon and Little Grand Rapids, Man.

#### Other applications:

● Dinosaur Broadcasting (CJDV Drumheller, CKBR Brooks, CHOA Stettler, Alta.), for transfer (69.3%) to CHUM Ltd.

● CJCD Radio Ltd., Yellowknife, NWT, for transfer of control to Charles Dent (50%) and Yellowknife Broadcasters Ltd. (50%).

● CJCM-FM Brandon, Man., for power increase to 100 kw.

● CBC, for TV rebroadcasters at Jean Côté, Alta. and Little Grand Rapids, Oak Lake, and Piney, Man.

● Local societies, for TV rebroadcasters at Grouard Mission and Slave Lake, Alta., Wollaston Post, Sask.

● Applications for new cable TV systems in Manitoba; Westman Media Co-op Ltd., for Birtle; Philip Chabot, for Elie and area; and Valley Cable Vision Ltd., for Steinbach.

#### HULL—JANUARY 12/14

A hearing has been scheduled for January 14, 1981, at the Conference Centre in Hull, Quebec, for applications by the CBC to establish its second TV service, to be known as CBC-2 in English and Tele-2 in French. Both networks would be national, non-commercial, and delivered via cable systems only.

#### CKO ON CARPET

At the hearing commencing January 12, the licence issued July 12, 1976, to Canada All-News Radio Ltd. will be considered for renewal. The network is now controlled by Research Foods (1976) Ltd. (a wholly-owned subsidiary of Agra Industries Ltd., which initially had a 45% interest in CANR), and the CRTC says that changes in ownership and control have occurred without the prior approval of the Commission.

Using the call letters CKO, CANR established FM stations in Ottawa, Toronto, London, Vancouver, Calgary and Edmonton, and purchased the AM station in Pointe-Claire, a suburb of Montreal. However, it has so far failed to establish new FM sta-

tions for which it was licensed in Regina, Winnipeg, Saint John, N.B., Halifax, and St. John's, Nfld. The original approval stipulated that all stations were to be in operation by the fall of 1979, and the CRTC now requires the licensee to "show cause why these licences should be renewed."

Also to be considered is the application by Allarco Broadcasting Ltd. of Edmonton to purchase the network. Allarco says it would complete the 12-station network "as soon as possible", but also proposes to add music to the CKO format—a proposal that appears to be in conflict with the original approval which stated that if the news network could not succeed financially, it must surrender all its licences rather than change programming.

#### Other applications

CBC, for new TV rebroadcasters at: Fort Frances, Ont.—10 kw, ch. 15, ex-CBWFT


Nipigon, Ont.—2.3 kw, ch. 16, ex-CBLT

Nipigon, Ont.—2.3 kw, ch. 26, ex-CBLFT



Owen Sound, Ont.—125 kw, ch. 20, ex-CKNX-TV.

Also, FM at Owen Sound, 100 kw on 98.7 MHz, ex-CBL Toronto; and power increases for CBEFT Windsor and CBWCT Fort Frances, Ont., and CBMT-3 Sherbrooke, Que.

● Native organizations, for low power FM stations in five communities, La Romaine, Mingan, Nain, Natashquan and St-Augustin, Quebec.




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JANUARY/FEBRUARY 1981

● CKFH Toronto, for a 26-station AM network to carry Maple Leafs hockey.

## DECISIONS

### AM RADIO

#### DEADLINE NOW JAN. 31 FOR 1-A CLEAR BIDS

The deadline for applications for new AM stations on Canada's seven Class 1-A clear channels has been extended from December 15, 1980, to January 31, 1981.

In the past, these channels (540, 690, 740, 860, 990, 1010 and 1580) were reserved for CBC use, but have now been made available for private stations. Industry response, however, indicates relatively few areas where the frequencies are suitable for use by new or existing stations. It is known that Standard Broadcasting is applying for a new station on 540 kHz in Ottawa, where it owns CJOH-TV.

#### NEW AM FOR NANAIMO

Robert Charles Adshead has won the bidding for a new AM station at Nanaimo, B.C. His application was for 10 kw on 1350 kHz, however, the decision (80-708) fails to specify power and frequency. Four competing applications were denied. The format will be "contemporary country" and \$15,000 will be allotted to develop local talent. The CRTC said Nanaimo could support a second station, opposed by both CHUB and one of the local newspapers, the Times.

#### APPLICATIONS CALLED

Applications for new AM stations have been called for the cities of Calgary, Alberta; Timmins, North Bay and Sudbury, Ontario; and St. Jerome, Quebec. The call for St. Jerome results from the revocation of the licence of CJEN (Radio Laurentides Inc.), which declared bankruptcy and ceased operation August 23, 1979. In the other locations, applications for new stations have already been received, and in Timmins an existing station is applying for a change of frequency.

#### Other AM decisions:

● Grand Falls, N.B.—application by J. Frank Johnson for a new English station (10 kw on 730 kHz) denied. It was opposed by French-language elements in the area.

● Drummondville, Que.—licence of CKRV revoked.

● Cornwall, Ont.—French-language daytime station CFIX has allowed its conditional approval for night-time operation to lapse. CFIX's application for 10 kw on 1600 kHz was ruled technically unacceptable by DOC, and the station failed to submit a revised proposal within the allotted six months. Two applications for new English-language stations in Cornwall were denied in favor of CFIX.

● Thunder Bay, Ont.—purchase of CFPA by Leader Broadcasting Corp. approved.

Leader will allocate an initial budget of \$30,000 to develop local musical talent.

● St. Albert, Alta.—transfer of control of CKST to QCTV Ltd. approved.

### FM RADIO

● Moncton, N.B.—application by student federation at University of Moncton for French FM, 50 watts on 105.7, denied. CRTC ruled that proposed programming "is not compatible with concept of student radio station" and would have been very similar to that of new AM station licensed to R. Landry. A new CBC FM station has also been licensed for Moncton, and the CRTC suggests a revised proposal to complement these services.

● Fredericton, N.B.—English station, 50 watts on 97.9, licensed to University of New Brunswick Student Union Inc. It will replace CHSR, an AM carrier-current operation.

● Campbellton/Neguac, N.B.—CBC French licences revised to 2.4 kw on 91.5 at Campbellton, 50 kw on 105.7 at Neguac, with new sites, for six months only. Current planning may require further changes to facilitate co-siting of FM and TV rebroadcasters.

● Sept-Iles, Que.—transfer of shares (33%) in Radio FM du Nord Ltee approved, from M. Paquet to the remaining two shareholders, C. Gagnon and J. Beaulieu.

● Gagnon, Que.—new community FM approved, 50 watts on 104.1. Because of isolated location, some conventional advertis-

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ing and programming from stations in Vermont and Sept-Iles have been permitted.

● Rivièrè-du-Loup, Que.—community FM on Class C channel (60 kw on 103.7) denied; CRTC receptive to revised proposal using Class A channel.

● Chateauguay, Que.—change in frequency approved for community station CHAI-FM to 101.9, 50 watts.

● Montreal, Que.—frequency of 104.5 approved for new Radio Maisonneuve community FM, 10 watts.

● Camp LG3, James Bay, Que.—French FM, 950 watts on 99.5, approved to rebroadcast CKAC.

● Sherbrooke, Que.—CBC English rebroadcaster approved, 25 kw on 92.1.

● Pembroke, Ont.—CBC English rebroadcaster approved, 100 kw on 96.7.

● Guelph, Ont.—co-siting of CKLA-FM with CJOY-AM approved.

● Hamilton, Ont.—transfer of CFMU-FM approved from McMaster Students Union Inc. to Alex Dashko, representing a company to be incorporated.

● Nipigon, Ont.—CBC rebroadcasters approved, French (ex-CBON Sudbury), on 97.3, English (ex-CBQ Thunder Bay) on 98.9, both 2 kw.

● Saskatoon, Sask.—power increase for CJUS-FM to 9.5 kw.

● Grande Prairie and Peace River, Alta.—SCMO approved on existing CKUA-FM rebroadcasters for purpose of educational broadcasts.

## TELEVISION

### GASPÉ SOLUTION

A rebroadcaster of CFER-TV Rimouski has been licensed to Entreprises Télé-Capitale Ltée, to serve communities along the south shore of the St. Lawrence River from Matane to Grande-Vallée. Operating on channel 5 with 23 kw, it will be sited across the river at Mont-Trouble, 60 miles away.

The licensee is to assess the quality of reception and report to the CRTC within six months, and is also to apply for a rebroadcaster at Grande-Vallée in the near future. A mobile unit is to be provided to cover activities in the Gaspé region.

The Commission, in its decision, notes the difficulty of serving the scattered communities along the river, many of which are located at the foot of cliffs. The CBC solution was to build a series of low-power transmitters, with two high-power stations at Ste-Anne-des-Monts and Grande-Vallée, however, this solution is costly and also has technical drawbacks.

### CAPTIONS FOR DEAF

Applications have been received by the CRTC from the CBC, CTV and TVOntario networks for the addition of closed captioning on line 21 of the vertical blanking interval. The captions, which are made visible through the use of a special decoding device, are to aid viewers with impaired hearing.

### Licences renewed:

● CKVU-TV Vancouver—4 year term. CRTC is satisfied that questions of control and local programming have been resolved.

● CFCM-TV Quebec City—5 year term. Station has promised to improve quality and extend distribution of its programs, participate more actively in TVA network, and develop new ideas such as televising performances of local theatrical productions.

## CABLE TV

### NEW SYSTEM OK'd

The following new cable TV licences have been approved:

● Headingley, Man.—to Philip Chabot. The sole applicant, Chabot is required to cooperate with Manitoba Telephone System in "Project Ida", a field trial involving videotex and other services in some 100 homes. A 15-year contract has been pro-

posed for the lease of facilities from MTS. Headingley is just west of Winnipeg.

● Minto, N.B.—to Charles David Hughes. The system is to be built in five stages over the next five years and will allot 5% of its revenues to community programming.

● Ste-Aurèlie, Que.—to Alain Larivière.

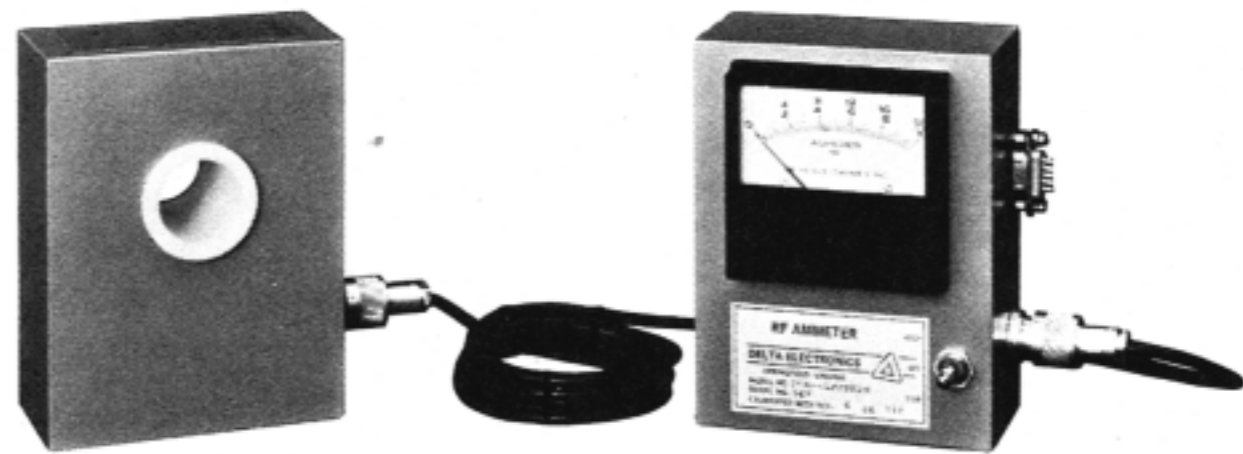
● Pender Harbour, B.C.—to Coast Cable Vision Ltd.

Also in B.C., the communities of Shawngan Lake, Cobble Hill and Mill Bay will be served by extending Cowichan Cablevision Ltd. A competing application by J.T. Prevost for a new system was denied.

### GANANOQUE IMPASSE

The licence to cable Gananoque, Ont., granted to Brockville Cable in 1977, has been renewed for 3 years. The system is not

# DELTA does it accurately



TCA-10/20-EXR Dual Scale Remote Output  
On/Off and Hi/Lo Switching.

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- MEETS FCC REQUIREMENTS OF 2% ACCURACY ●
- MINIMUM MODULATION EFFECT ●
- ALL COMPONENTS CAN BE GROUNDED FOR SAFETY ●
- ON/OFF SWITCH FOR GREATER LIGHTNING PROTECTION ●
- PATENTED TEMPERATURE COMPENSATED RECTIFIER CIRCUIT ●
- WIDE TEMPERATURE RANGE  $-40^{\circ}\text{F}$  to  $+150^{\circ}\text{F}$  ●

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