BUREAU INTERNATIONAL DE L'HEURE - ANNUAL REPORT - 1981

FEDERATION OF ASTRONOMICAL AND GEOPHYSICAL SERVICES

BUREAU INTERNATIONAL DE L'HEURE

ANNUAL REPORT FOR 1981

EXTRACT: PAGES B-19 TO C-11

Published for the International Council of Scientific Unions

with the financial assistance of the U N E S C O

Prepared with the participation of the Bureau International des Poids et Mesures

PARIS — 1982

All communications should be addressed to :

M. le Directeur, Bureau International de l'Heure - 61, avenue de l'Observatoire - 75014 Paris

Table 9 - Offsets and step adjustments of UTC, until 1982 Dec. 31

Date (at 0h UTC)			Offsets	Steps
1961	Jan.	1	-150×10^{-10}	
	Aug.	1	"	+ 0.050s
1962	Jan.	1	-130×10^{-10}	
1963	Nov.	1	"	- 0.100s
1964	Jan.	1	-150×10^{-10}	
	April	1	"	- 0.100s
	Sept.	1	"	- 0.100s
1965	Jan.	1	"	- 0.100s
	March	1	"	- 0.100s
	July	1	"	- 0.100s
	Sept.	1	"	- 0.100s
1966	Jan.	1	-300×10^{-10}	
1968	Feb.	1	"	+ 0.100s
1972	Jan.	1	0	- 0.107 7580s
	July	1	"	- 1s
1973	Jan.	1	"	- 1s
1974	Jan.	1	"	- 1s
1975	Jan.	1	"	- 1s
1976	Jan.	1	"	- 1s
1977	Jan	1	"	- 1s
1978	Jan.	1	"	- 1s
1979	Jan.	1	"	- 1s
1980	Jan.	1	"	- 1s
1981	July	1	"	- 1s
1982	July	1	"	- 1s

Table 10 - Relationship between TAI and UTC, until 1982 Dec. 31

Limits of validity (at 0h UTC)	TAI – UTC
1961 Jan. 1 - 1961 Aug. 1	1.422 818 0 s + (MJD - 37 300) x 0.001 296 s
Aug. 1 - 1962 Jan. 1	1.372 818 0 s + " "
1962 Jan. 1 - 1963 Nov. 1	1.845 858 0 s + (MJD - 37 665) x 0.001 123 2 s
1963 Nov. 1 - 1964 Jan. 1	1.945 858 0 s + " "
1964 Jan. 1 - April 1	3.240 130 0 s + (MJD - 38 761) x 0.001 296 s
April 1 - Sept. 1	3.340 130 0 s + " "
Sept. 1 - 1965 Jan. 1	3.440 130 0 s + " "
1965 Jan. 1 - March 1	3.540 130 0 s + " "
March 1 - July 1	3.640 130 0 s + " "
July 1 - Sept. 1	3.740 130 0 s + " "
Sept. 1 - 1966 Jan. 1	3.840 130 0 s + " "
1966 Jan. 1 - 1968 Feb. 1	4.313 170 0 s + (MJD - 39 126) x 0.002 592 s
1968 Feb. 1 - 1972 Jan. 1	4.213 170 0 s + " "
1972 Jan. 1 - July 1	10.000 000 0 s
July 1 - 1973 Jan. 1	11.000 000 0 s
1973 Jan. 1 - 1974 Jan. 1	12.000 000 0 s
1974 Jan. 1 - 1975 Jan. 1	13.000 000 0 s
1975 Jan. 1 - 1976 Jan. 1	14.000 000 0 s
1976 Jan. 1 - 1977 Jan. 1	15.000 000 0 s
1977 Jan. 1 - 1978 Jan. 1	16.000 000 0 s
1978 Jan. 1 - 1979 Jan. 1	17.000 000 0 s
1979 Jan. 1 - 1980 Jan. 1	18.000 000 0 s
1980 Jan. 1 - 1981 July 1	19.000 000 0 s
1981 July 1 - 1982 July 1	20.000 000 0 s
1982 July 1 -	21.000 000 0s

Table 11 - Atomic time, collaborating laboratories

AOS	Astronomical Latitude Observatory, Borowiec, Polska
APL	Applied Physics Laboratory, Laurel, USA
ASMW	Amt für Standardisierung, Messwesen und Warenprünfung, Berlin, Deutsche Demokratische Republik
ASUA	Allgemeine Schweizerische Uhrenindustrie AG, Bienne, Suisse
ATC	Australian Telecommunications Commission, Melbourne, Australia
BEV	Bundesamt für Eich - und Vermessungswesen, Wien, Österreich
BO	Beijing Observatory, Beijing, Peoples Republic of China
CAO	Astronomical Observatory of Cagliari University, Cagliari, Italy
CSAO	Shaanxi Astronomical Observatory, Lintong, China
DHI	Deutsches Hydrographisches Institut, Hamburg, Bundesrepublik Deutschland
DNM	Division of National Mapping, Canberra, Australia
F	Commission Nationale de l'Heure, Paris, France
FTZ	Fernmeldetechnisches Zentralamt, Darmstadt, Bundesrepublik Deutschland
IEN	Istituto Elettrotecnico, Nazionale, Torino, Italia
IFAG	Institut für Angewandte Geodäsie, Frankfurt am Main, Bundesrepublik Deutschland
IGMA	Instituto Geographico Militar, Buenos-Aires, Argentina
ILOM	International Latitude Observatory, Mizusawa, Japan
KSRI	Korea Standards Research Institute, Korea
MSSD	Measurement Standards and Services Division, Colombo, Sri Lanka
NBS	National Bureau of Standards, Boulder, USA
NIM	National Institute of Metrology, Beijing, China
NIS	National Institute for Standards, Cairo, Arab Republic of Egypt
NML	National Measurement Laboratory, CSIRO, Australia
NPL	National Physical Laboratory, Teddington, U. K.
NPLI	National Physical Laboratory, New-Dehli, India
NPRL	National Physical Research Laboratory, Pretoria, South Africa
NRC	National Research Council of Canada, Ottawa, Canada
NRLM	National Research Laboratory of Metrology, Tsukuba, Japan
OAB	Observatoire Astronomique Bouzaréah, Alger, République Algérienne
OMH	Országos Mérésügyi Hivatal, Budapest, Hungary
OMSF	Instituto y Observatorio de Marina, San Fernando, España
ON	Observatoire de Neuchâtel, Neuchâtel, Suisse
ONBA	Observatorio Naval, Buenos-Aires, Argentina
ONRJ	Observatorio National, Rio de Janeiro, Brazil
OP	Observatoire de Paris, Paris, France
ORB	Observatoire Royal de Belgique, Bruxelles, Belgique

Table 11 - Atomic time, collaborating laboratories (cont.)

PAGA	Philippine Atmospheric, Geophysical and Astronomical Services Administration, Philippine
PEL	Physics and Engineering Laboratory, New-Zealand
PKNM	Polski Komitet Normalizacji i Miar, Warszawa, Polska
PTB	Physikalisch-Technische Bundesanstalt, Braunschweig, Bundesrepublik Deutschland
PTCH	Direction générale des PTT, Berne, Suisse
RGO	Royal Greenwich Observatory, Herstmonceux, U. K.
RO	Royal Observatory, Hong-Kong
RRL	Radio Research Laboratories, Tokyo, Japan
SIS	Singapore Institute of Standards and Industrial Research, Singapore
SO	Shanghaï Observatory, Shanghaï, China
STA	Swedish Telecommunications Administration, Stockholm, Sweden
SU	Laboratoire d'état de l'étalon de temps et de fréquences, URSS
TAO	Tokyo Astronomical Observatory, Tokyo, Japan
TL	Telecommunication Laboratories, Taiwan, China
TP (1)	Ústav Radiotechniky a Electroniky, Praha, Československo
	Astronomický Ústav, Praha, Československo
TPC	Telecommunication Public Corporation, Indonesia
TUG	Technische Universität Graz, Österreich
USNO	U. S. Naval Observatory, Washington D. C., USA
VSL	Van Swinden Laboratorium, Den Haag, Nederland
ZIPE	Zentralinstitut Physik der Erde, Potsdam, Deutsche Demokratische Republik

(1) Both laboratories cooperate in the derivation of UTC (TP).

Table 12 - Laboratories keeping an independent local atomic time

Laboratory (i)	Equipment in atomic standards(1)	Information on TA(i) - UTC(i): Interval of validity (in MJD at 0h UT)	TA(i) - UTC(i) in s
DDR	4 Ind. Cs	year 1981 (2)	(3)
F(4)	18 Ind. Cs	year 1981	TA(F) – UTC(OP) is published in Bulletin H by OP (LPTF)
NBS	14 Ind. Cs 2 lab. Cs 2 H. Masers (5)	44605 - 44786	19.045 065 870 $- (9.74 \times 10^{-9})$ (MJD - 44 605) $+ (11.83 \times 10^{-12})$ (MJD - 44605)^2
		44786 - 44970	20.045 065 283 $- (5.09 \times 10^{-9})$ (MJD - 44786)
NRC	1 Ind. Cs 1 2.1 m lab. Cs 3 1. m lab. Cs (6)	44605 - 44786 44786 - 44970	18.999 968 931 19.999 968 931
PTB	11 Ind. Cs 1 lab. Cs (7)	44605 - 44786 44786 - 44970	19.000 363 400 20.000 363 400
RGO	7 Ind. Cs	44605 - 44786 44786 - 44970	18.999 926 09 19.999 926 09
RRL	7 Ind. Cs 2H. Masers	year 1981	published in RRL Standard Frequency and Time Service Bulletin
USNO	35 Ind. Cs 1 H. Maser	year 1981	A.1 (USNO, MEAN) - UTC(USNO, MC) : provisional values in USNO series 7 ; final values in USNO series 11. (8)

Table 12 (cont.)

(1) Ind. Cs designates an industry made Cs standard ; lab. Cs a laboratory Cs standard and H. Maser an Hydrogen Maser.

(2) The standards are located as follows :

ASMW : 3 Cs

ZIPE : 1 Cs

They are intercompared by TV Method.

(3) Given in ASMW Bulletin.

(4) The standards are located as follows (at the end of 1981).

Centre Electronique de l'Armement (Rennes)	1 Cs
Centre National d'Études Spatiales	2 Cs
Centre National d'Études des Télécommunications	4 Cs
Centre d'Études et de Recherches Géodynamiques et Astronomiques	2 Cs
Électronique Marcel Dassault (Suresnes)	1 Cs
Hewlett - Packard (Orsay)	1 Cs
Observatoire de Paris : Laboratoire Primaire du Temps et des Fréquences (LPTF)	5 Cs
Observatoire de Besançon	1 Cs
Société Nationale Industrielle Aérospatiale (Toulouse)	1 Cs

They are intercompared by the TV method and linked to the foreign laboratories through OP (LPTF) (see Table 13).

(5) The laboratory primary standards control TA (NBS) via an accuracy algorithm. One of the two primary standards usually operates as a contributing member clock. Three of the commercial standards provide the reference for WWV and WWVB but do not contribute directly to TA(NBS) ; they are available for NBS time scales back-up and are compared to TA(NBS) to within 0.1 μs. The hydrogen masers are passively operated.

(6) The 2.1 meter primary cesium clock, CsV, operated continuously during 1981, producing the scale of proper time PT(NRC CsV). The time scales UTC(NRC) and TA(NRC) were derived from PT(NRC CsV) according to the following expressions given in microseconds :

$$\text{UTC(NRC)} = \text{PT(NRC CsV)} - (\text{MJD} - 43144) \times 0.000\,97 + 52.041$$

$$\text{TA(NRC)} = \text{PT(NRC CsV)} - (\text{MJD} - 43144) \times 0.000\,97 + 20.972$$

with integral seconds disregarded.

Three 1 meter laboratory cesium clocks, CsVIA, -B, and -C, operated continuously as primary standards during 1981, producing the scales of proper time PT (NRC Cs VI A), PT(NRC Cs VI B), and PT(NRC Cs VI C).

(7) TA(PTB) and UTC(PTB) are derived directly from a local oscillator monitored by the primary clock CS1. MEZ(D) = UTC(PTB) + 1 h or MESZ(D) = UTC(PTB) + 2 h (summer time) is the legal time of the Federal Republic of Germany.

(8) TA(USNO) is designated by A.1 (USNO, MEAN) in USNO publications.

Table 13 - Equipment and links of the collaborating laboratories

Laboratory (i)	Equipment (1)	Source of UTC(i)	LORAN-C receptions (2)	VLF and LF receptions (3)	Television link with	Satellite link with
AOS	1 Ind. Cs	1 Cs		DCF77, OMA 50, HBG 75	TP, ZIPE	
APL (4)	3 Ind. Cs	1 Cs + microstepper			USNO	
ASMW	2 Ind. Cs	corrected mean of 2 Cs	7970-W	DCF77, OMA	ZIPE, TP, PTB, PKNM, SU	
ASUA	4 Ind. Cs 4 prototype Cs		7970-W 7990-Z			
BEV	1 Ind. Cs	1 Cs	7970-W 7990-M 7990-X 7990-Y (5)	GBR, OMA 50, MSF60, HBG, DCF77	TUG, lab. in Czechoslovakia	
CAO	2 Ind. Cs	1 Cs	7990-M 7990-X 7990-Z	DCF77, HBG	IEN	
CSAO	3 Ind. Cs 2 H Masers	1 Cs	9970-Y	NWC, GBR,	lab. in China	
DHI	2 Ind. Cs	1 Cs + microstepper	7970-W	DCF77	PTB, TP, ZIPE	
DNM (6)	4 Ind. Cs	all the Cs			other lab. in Australia	
FTZ	7 Ind. Cs	1 Cs	7970-W	DCF77, MSF		
IEN	7 Ind. Cs	1 Cs + microstepper	7990-M 7990-Z	GBR	CAO, other lab. in Italy	
IFAG	3 Ind. Cs	1 Cs	7970-W			
IGMA	3 Ind. Cs	Cs		OMEGA/A	ONBA, other lab. in Argentina	
ILOM	4 Ind. Cs	1 Cs	9970-M	OMEGA/H	RRL, TAO, NRLM	
NBS	see Table 12	10 Cs 1 lab. Cs 1 H Maser	9940-M 9960-Z	OMEGA/ND, OMEGA/H	NRC, USNO	USNO via GPS
NIM	4 Ind. Cs	all the Cs	9970-Y		lab. in China	
NPL	4 Ind. Cs 1 lab. Cs	1 Cs	7970-W	GBR, MSF60	RGO, transmitting station at Rugby	
NPLI	3 Ind. Cs	1 Cs		GBR, OMEGA/J, OMEGA/LR, /L, /N		
NPRL	1 Ind. Cs	1 Cs		GBR, OMEGA/L		

Table 13 - (cont.)

Laboratory (i)	Equipment (1)	Source of UTC(i)	LORAN-C receptions (2)	VLF and LF receptions (3)	Television link with	Satellite link with
NRC	see Table 12	Cs V	9960-M		NBS, USNO	OP, PTB via Symphonie
NRLM	3 Ind. Cs 2 lab. Cs	1 Cs	9970-M		ILOM, RRL, TAO	
OAB	2 Ind. Cs	1 Cs	7990-Z			
OMH	1 Ind. Cs	1 Cs			TP	
OMSF	5 Ind. Cs	all the Cs	7990-Z			
ON	5 Ind. Cs	all the Cs	7970-W 7990-Z			
ONBA	2 Ind. Cs	2 Cs		OMEGA/T	IGMA	
ONRJ	2 Ind. Cs	2 Cs		GBR, OMEGA	other lab. in Brasil	
OP	5 Ind. Cs	1 Cs	7970-W 7990-Z		19 lab. in France, ORB, Hewlett-Packard (Switzerland), PTCH	NRC, PTB via Symphonie
ORB	2 Ind. Cs	1 Cs	7970-W		OP	
PKNM	4 Ind. Cs	corrected mean of 4 Cs	7970-W (5)	DCF77, OMA50, RBU66	ASMW	
PTB	see Table 12	Ind. Cs steered by PTB primary standard	7970-W	GBR, DCF77	ASMW, DHI, TP, ZIPE and other lab.	NRC, OP via Symphonie VSL via OTS
PTCH	2 Ind. Cs	2 Cs	7970-W	DCF77, HBG	OP and other lab. in Switzerland	
RGO	see Table 12	selection of the Cs	7930-X 7970-M 7970-W 7990-Z	GBR, MSF60	NPL	
RRL	see Table 12	1 Cs	9970-M	OMEGA/H, OMEGA/J	ILOM, TAO, NRLM	
SO	1 lab. Cs 3 H Masers	1 Rb + microstepper	9970-Y		lab. in China	
STA	3 Ind. Cs	1 Cs	7970-W	GBR	other lab. in Sweden	
SU	1 lab. Cs 4 Ind. Cs 4 H. Masers 4 H clocks	1 lab. Cs 2 Cs 3 H Masers 3 H clocks	7990-X 7990-Y 9970-M	GBR, OMA50, RBU, OMEGA/J	other lab. in URSS, ASMW, TP	
TAO	5 Ind. Cs	1 Cs	9970-M	NWC	ILOM, RRL, NRLM	
TL	4 Ind. Cs	all the Cs	9970-M	NDT, NWC		

Table 13 - (cont.)

Laboratory (i)	Equipment (1)	Source of UTC(i)	LORAN-C receptions (2)	VLF and LF receptions (3)	Television link with	Satellite link with
TP	1 Ind. Cs	1 Cs + microstepper		DCF77	DHI, PTB, AOS, SU ZIPE, ASMW, OMH	
TUG	2 Ind. Cs	1 Cs	7970-W 7990-M	OMEGA, GBR, DCF77	BEV	VSL via OTS
USNO(7)(8)	see Table 12	Cs	(9)	(9)	APL, NBS, NRC	NBS via GPS
VSL(8)	4 Ind. Cs	Cs	7970-M 7970-W 7930-X	DCF77	other lab. in Holland	PTB, TUG via OTS
ZIPE	1 Ind. Cs	1 Cs	7970-W	DCF77, GBR, OMA50, HBG, OMEGA/N	ASMW, DHI, PTB, TP, AOS	

Notes

(1) Ind. Cs designates an industry made Cs standard ; lab. Cs a laboratory Cs standard and H. Maser an Hydrogen Maser. Rb designates a Rubidium standard.

(2) LORAN-C stations :

7930-M	North Atlantic chain, Angissog	9940-M	West Coast chain, Fallon
7930-X	" " Ejde		
7970-M	Norwegian Sea chain, Ejde	9960-M	Northeast Coast chain, Seneca
7970-W	" " Sylt	9960-X	" " Nantucket
7990-M	Mediterranean chain, Simeri Crichi	9960-Z	" " Dana
7990-X	" " Lampedusa		
7990-Y	" " Kargabarun	9970-M*	Northwest Pacific chain, Iwo Jima
7990-Z	" " Estartit	9970-Y	" " " Gesashi

* Reconfiguration (rate 7930) from Feb. 21 to Mar. 31

(3) OMEGA stations :

/A	Argentina	/H	Hawaii	/J	Japan
/L	Liberia	/LR	La Réunion	/N	Aldra, Norway
/ND	Lamoure, North Dakota USA	/T	Trinidad, West Indies		

(4) Weekly Cesium transfers are carried out between APL and USNO.

(5) Reception of the Soviet Union LORAN chain 8000.

(6) Microware link with Orroral facility of NASA (National Aeronautics and Space Administration).

(7) USNO Time Service Publication, Series 16, entitled Precise Time Transfer Report, lists UTC(USNO MC) - UTC (Reference Clock). Difference from Satellite Communication terminals as well as many international timing centers are reported. USNO Time Service Publication, Series 17, entitled Transit Satellite Reports, lists UTC(USNO MC) - UTC (Satellite Clock) and also the frequency offset of each satellite.

(8) Experimental VLBI link between USNO and VSL.

(9) The daily phase values Series 4 of the USNO give the values of UTC(USNO MC) – transmitting station for :

the LORAN -C chains
the OMEGA stations A, H, L, ND
the VLF stations GBR, NLK
the US TV Networks
the NNSS and GPS satellite systems

TABLE 14 - TIME COMPARISONS BETWEEN LABORATORIES BY CLOCK TRANSPORTATION IN 1981

UNLESS OTHERWISE STATED,THE TRANSPORTATION WAS CARRIED OUT BY THE FIRST MENTIONED LABORATORY

DATE		MJD	TIME COMPARISONS		UNCERT.	SOURCE
1981			(UNIT : 1 MICROSECOND)			
JAN	6	44610.1	UTC(USNO) - UTC(DNM) =	-1.7	0.2	USNO DPV 733 (1) (2)
JAN	8	44612.3	UTC(USNO) - UTC(ATC) =	-34.8	0.2	USNO DPV 733
JAN	26	44630.5	UTC(USNO) - UTC(NRC) =	-8.5	0.5	USNO DPV 732
JAN	30	44634.5	UTC(NBS) - UTC(USNO) =	0.6	0.3	NBS BULL 279
MAR	25	44688.6	UTC(PTB) - UTC(IFAG) =	-15.195		IFAG LETTER
APR	9	44703.8	UTC(NBS) - UTC(USNO) =	0.14	0.3	NBS BULL 282
APR	17	44711.1	UTC(USNO) - UTC(NBS) =	-0.18	0.3	NBS BULL 282
APR	22	44716.4	UTC(USNO) - UTC(PTB) =	0.6	0.1	USNO DPV 747
APR	23	44717.3	UTC(USNO) - UTC(DHI) =	0.4	0.1	USNO DPV 747
APR	24	44718.6	UTC(USNO) - UTC(IFAG) =	-15.5	0.1	IFAG LETTER
APR	28	44722.3	UTC(USNO) - UTC(TUG) =	-2.8	0.2	USNO DPV 747
APR	28	44722.6	UTC(USNO) - UTC(BEV) =	-6.1	0.2	USNO DPV 754
APR	29	44723.5	UTC(USNO) - UTC(ON) =	12.6	0.2	USNO DPV 747
MAY	5	44729.5	UTC(USNO) - UTC(RGO) =	-5.1	0.1	USNO DPV 747
MAY	6	44730.3	UTC(USNO) - UTC(NPL) =	4.3	0.1	USNO DPV 750
MAY	15	44739.0	UTC(NIM) - UTC(OP) =	12.346	0.100	NIM LETTER
MAY	18	44742.0	UTC(TAO) - UTC(RRL) =	-1.83	0.01	TAO LETTER
MAY	18	44742.99	UTC(TAO) - UTC(NRLM) =	-62.87	0.01	TAO LETTER
MAY	27	44751.99	UTC(NBS) - UTC(USNO) =	0.19	0.3	NBS BULL 283
JUN	2	44757.3	UTC(USNO) - UTC(OP) =	-0.26	0.04	USNO DPV 751
JUN	3	44758.0	UTC(TAO) - UTC(ILOM) =	-37.18	0.02	TAO LETTER
JUN	3	44758.4	UTC(USNO) - UTC(ORB) =	5.15	0.05	USNO DPV 751
JUN	4	44759.2	UTC(USNO) - UTC(VSL) =	1.71	0.06	USNO DPV 751
JUN	11	44766.4	UTC(USNO) - UTC(NPL) =	4.09	0.03	USNO DPV 751
JUN	15	44770.2	UTC(USNO) - UTC(DNM) =	-5.1	0.2	USNO DPV 758 (2)
JUL	24	44809.9	UTC(USNO) - UTC(NBS) =	-0.571	0.02	NBS BULL 286
JUL	28	44813.6	UTC(USNO) - UTC(NBS) =	-0.62	0.06	USNO DPV 760
AUG	4	44820.4	UTC(USNO) - UTC(NRC) =	-8.56	0.08	USNO DPV 761
AUG	21	44837.1	UTC(USNO) - UTC(RRL) =	-5.0	0.1	USNO DPV 767
AUG	23	44839.2	UTC(USNO) - UTC(TAO) =	-5.5	0.1	USNO DPV 767
AUG	24	44840.4	UTC(USNO) - UTC(SO) =	-5.9	0.1	USNO DPV 767
AUG	28	44844.2	UTC(USNO) - UTC(CSAO) =	-3.2	0.1	CSAO LETTER
AUG	31	44847.0	UTC(USNO) - UTC(BO) =	5.1	0.1	USNO DPV 767
SEP	1	44848.1	UTC(NBS) - UTC(USNO) =	1.008	0.01	NBS BULL 286
SEP	9	44856.3	UTC(ILOM) - UTC(RRL) =	52.4	0.2	ILOM LETTER
OCT	6	44883.8	UTC(PTB) - UTC(IFAG) =	-23.275		IFAG LETTER
OCT	9	44886.4	UTC(NBS) - UTC(OP) =	-0.25	0.02	NBS BULL 290
OCT	9	44886.9	UTC(USNO) - UTC(DNM) =	-3.23	0.05	USNO DPV 772 (2)
OCT	14	44891.6	UTC(TP) - UTC(OMH) =	-0.2	0.1	TP LETTER
OCT	19	44896.0	UTC(TAO) - UTC(RRL) =	1.10	0.01	TAO LETTER
OCT	20	44897.0	UTC(TAO) - UTC(NRLM) =	-53.60	0.02	TAO LETTER
OCT	22	44899.4	UTC(NBS) - UTC(OP) =	-0.16	0.02	NBS BULL 290
OCT	27	44904.0	UTC(TAO) - UTC(ILOM) =	-58.76	0.05	TAO LETTER
NOV	6	44914.6	UTC(USNO) - UTC(NBS) =	-1.75	0.02	USNO DPV 776
NOV	17	44925.5	UTC(PKNM) - UTC(ASMW) =	2.421		PKNM LETTER
DEC	1	44939.2	UTC(NBS) - UTC(USNO) =	2.02	0.04	NBS BULL 289
DEC	9	44947.5	UTC(PKNM) - UTC(SU) =	26.288		PKNM LETTER

COMPLEMENTARY RESULTS FOR THE PREVIOUS YEAR

1980						
MAR	11	44309.1	UTC(USNO) - UTC(DNM) =	1.8		DNM LETTER (2) (3)
APR	10	44339.3	UTC(ILOM) - UTC(RRL) =	14.9	0.2	ILOM LETTER
AUG	19	44470.3	UTC(ILOM) - UTC(RRL) =	27.4	0.2	ILOM LETTER
SEP	8	44490.1	UTC(USNO) - UTC(DNM) =	3.1		DNM LETTER (3)
NOV	13	44556.3	UTC(ILOM) - UTC(RRL) =	33.6	0.2	ILOM LETTER

(1) UTC(USNO) STANDS FOR UTC(USNO MC)
DPV:DAILY PHASE VALUES,SERIES 4,PUBLISHED BY USNO

(2) UTC(DNM) IS OBTAINED VIA THE VALUES UTC(DNM)-UTC(CS 1109)
PUBLISHED IN THE BULLETIN E OF DNM

(3) MADE BY BENDIX FIELD ENGINEERING CORPORATION ON BEHALF OF NASA

TABLE 14 - (CONT.)

CLOCK TRANSPORTATIONS CARRIED OUT BY PHYSICS AND ENGINEERING LABORATORY (PEL), NEW ZEALAND

DATE		MJD	TIME COMPARISONS		UNCERT.
1981			(UNIT : 1 MICROSECOND)		
FEB	3	44642.0	UTC(PEL) - UTC(NML CS 201) =	-92.5	0.1
FEB	5	44650.7	UTC(PEL) - UTC(NPLI CS 1730) =	-53.6	0.2
FEB	19	44654.0	UTC(PEL) - UTC(MSSD CS 732) =	-26.2	0.3
MAR	2	44665.5	UTC(PEL) - UTC(SIS RB 674) =	-27.2	0.5
OCT	13	44890.4	UTC(PEL) - UTC(NML CS 201) =	-89.8	0.1
OCT	22	44899.5	UTC(PEL) - UTC(TPC CS 584) =	4.7	0.8
OCT	27	44904.1	UTC(PEL) - UTC(PAGA X 400) =	12	2
OCT	30	44907.9	UTC(PEL) - UTC(KSRI CS 1516) =	23.0	0.5
NOV	5	44913.2	UTC(PEL) - UTC(NRLM CS 906) =	-52.8	0.4
NOV	10	44918.0	UTC(PEL) - UTC(NIM) =	-8.1	0.3
NOV	14	44922.5	UTC(PEL) - UTC(RO CS 1516) =	2.4	0.2

CLOCK TRANSPORTATIONS CARRIED OUT BY IGMA AND ONBA

DATE		MJD	TIME COMPARISONS	
1978			(UNIT : 1 MICROSECOND)	
FEB	16	43555.7	UTC(IGMA) - UTC(OP) =	-1.18
FEB	17	43556.7	UTC(IGMA) - UTC(RGO) =	-0.55
FEB	23	43562.7	UTC(IGMA) - UTC(USNO) =	-1.36
MAR	1	43568.6	UTC(IGMA) - UTC(ONBA) =	-13.56
NOV	21	43833.9	UTC(ONBA) - UTC(IGMA) =	-32.67
NOV	24	43836.6	UTC(ONBA) - UTC(USNO) =	-27.16

UTC(IGMA) STANDS FOR UTC(IGMA CS2)
UTC(ONBA) STANDS FOR UTC(ONBA CS2)

TABLE 15 - INDEPENDENT ATOMIC TIMES

TA(I) DENOTES THE ATOMIC TIME OF THE LABORATORY I

UNIT IS ONE MICROSECOND

DATE 1981	MJD	TAI - TA(I) DDR (1)	F	NBS	NRC
JAN 5	44609	60.22	-60.78	-45065.53	22.87
JAN 15	44619	61.46	-60.43	-45065.46	22.89
JAN 25	44629	62.76	-60.04	-45065.31	23.00
FEB 4	44639	63.82	-59.74	-45064.91	23.01
FEB 14	44649	65.09	-59.38	-45064.90	23.10
FEB 24	44659	66.38	-59.02	-45064.98	23.18
MAR 6	44669	67.64	-58.69	-45064.96	23.22
MAR 16	44679	68.91	-58.26	-45064.74	23.28
MAR 26	44689	70.32	-57.83	-45064.68	23.37
APR 5	44699	71.77	-57.50	-45064.53	23.43
APR 15	44709	73.33	-57.05	-45064.43	23.52
APR 25	44719	74.84	-56.75	-45064.28	23.56
MAY 5	44729	76.41	-56.44	-45064.25	23.59
MAY 15	44739	77.99	-56.04	-45064.21	23.63
MAY 25	44749	79.57	-55.65	-45064.21	23.65
JUN 4	44759	81.18	-55.23	-45064.18	23.65
JUN 14	44769	82.75	-54.83	-45064.13	23.68
JUN 24	44779	84.28	-54.41	-45064.91	23.69
JUL 4	44789	85.87	-54.05	-45064.93	23.68
JUL 14	44799	87.42	-53.70	-45064.93	23.63
JUL 24	44809	88.88	-53.39	-45064.90	23.62
AUG 3	44819	90.37	-52.97	-45064.91	23.51
AUG 13	44829	91.92	-52.53	-45064.87	23.48
AUG 23	44839	93.60	-52.21	-45064.85	23.46
SEP 2	44849		-51.84	-45064.79	23.42
SEP 12	44859		-51.52	-45064.77	23.39
SEP 22	44869		-51.19	-45064.73	23.34
OCT 2	44879		-50.78	-45064.70	23.31
OCT 12	44889		-50.42	-45064.65	23.25
OCT 22	44899		-50.09	-45064.66	23.16
NOV 1	44909		-49.73	-45064.63	23.11
NOV 11	44919		-49.32	-45064.64	23.05
NOV 21	44929		-48.97	-45064.64	23.01
DEC 1	44939		-48.59	-45064.65	22.95
DEC 11	44949		-48.24	-45064.58	22.93
DEC 21	44959		-47.95	-45064.52	22.92
DEC 31	44969		-47.53	-45064.48	23.01

(1) From 1981 September 2 (MJD = 44 849), the computation of TA(DDR) was stopped.

TABLE 15 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1981	MJD	TAI - TA(I) PTB	RGO	RRL	USNO
JAN 5	44609	-362.81	69.98	10.2	-34446.29
JAN 15	44619	-362.80	69.88	10.4	-34446.73
JAN 25	44629	-362.71	69.76	10.4	-34447.27
FEB 4	44639	-362.77	69.69	10.6	-34447.61
FEB 14	44649	-362.73	69.60	10.8	-34448.06
FEB 24	44659	-362.65	69.54	9.8	-34448.52
MAR 6	44669	-362.57	69.51	10.2	-34448.87
MAR 16	44679	-362.57	69.31	10.2	-34449.29
MAR 26	44689	-362.43	69.34	10.2	-34449.82
APR 5	44699	-362.40	69.33	11.2	-34450.28
APR 15	44709	-362.33	69.28	11.7	-34450.67
APR 25	44719	-362.31	69.18	11.4	-34451.04
MAY 5	44729	-362.28	69.09	11.2	-34451.42
MAY 15	44739	-362.32	69.06	11.1	-34451.83
MAY 25	44749	-362.30	68.89	11.5	-34452.25
JUN 4	44759	-362.32	68.75	11.8	-34452.61
JUN 14	44769	-362.31	68.64	11.5	-34453.01
JUN 24	44779	-362.34	68.54	11.2	-34453.36
JUL 4	44789	-362.37	68.43	11.3	-34453.72
JUL 14	44799	-362.42	68.24	11.7	-34454.05
JUL 24	44809	-362.54	68.03	11.8	-34454.32
AUG 3	44819	-362.55	67.91	11.9	-34454.70
AUG 13	44829	-362.63	67.82	12.1	-34455.02
AUG 23	44839	-362.67	67.59	12.2	-34455.35
SEP 2	44849	-362.70	67.35	12.1	-34455.66
SEP 12	44859	-362.75	67.18	11.9	-34455.97
SEP 22	44869	-362.82	66.96	11.6	-34456.26
OCT 2	44879	-362.82	66.76	11.6	-34456.53
OCT 12	44889	-362.86	66.53	11.5	-34456.82
OCT 22	44899	-362.92	66.30	11.2	-34457.16
NOV 1	44909	-362.95	66.12	11.1	-34457.45
NOV 11	44919	-363.02	65.90	10.8	-34457.80
NOV 21	44929	-363.08	65.97	10.6	-34458.18
DEC 1	44939	-363.16	65.71	11.1	-34458.57
DEC 11	44949	-363.18	65.39	11.0	-34458.87
DEC 21	44959	-363.21	65.02	10.7	-34459.22
DEC 31	44969	-363.15	64.72	10.5	-34459.61

NOTE - The uncertainties of the computed values of TAI-TA(i) are of a few 0.1 µs. However, in order to avoid rounding errors, the results are given to ± 0.01 µs.

TABLE 16 - PRIMARY STANDARDS USED AS CLOCKS

UNIT IS ONE MICROSECOND

DATE 1981	MJD	TAI-LAB.STD. PTB CS1	NRC CSV	NRC CSVI A	NRC CSVI B	NRC CSVI C
JAN 5	44609	0.59	42.42	37.47	40.71	38.42
JAN 15	44619	0.61	42.43	37.39	40.70	38.49
JAN 25	44629	0.68	42.53	37.47	40.80	38.66
FEB 4	44639	0.63	42.54	37.43	40.81	38.75
FEB 14	44649	0.68	42.62	37.49	40.88	38.89
FEB 24	44659	0.75	42.68	37.54	40.95	38.87
MAR 6	44669	0.83	42.72	37.54	40.93	38.80
MAR 16	44679	0.84	42.77	38.54	40.92	38.74
MAR 26	44689	0.97	42.84	37.56	40.95	38.74
APR 5	44699	1.00	42.90	37.57	40.99	38.75
APR 15	44709	1.07	42.98	37.62	41.04	38.83
APR 25	44719	1.09	43.00	37.61	41.03	38.83
MAY 5	44729	1.12	43.02	37.62	41.05	38.86
MAY 15	44739	1.08	43.05	37.64	41.07	38.88
MAY 25	44749	1.10	43.07	37.64	41.07	38.90
JUN 4	44759	1.07	43.05	37.63	41.07	38.92
JUN 14	44769	1.09	43.08	37.61	41.06	38.94
JUN 24	44779	1.06	43.08	37.59	41.02	38.98
JUL 4	44789	1.04	43.05	37.53	40.99	38.99
JUL 14	44799	0.97	42.99	37.47	40.96	39.00
JUL 24	44809	0.87	42.97	37.44	40.96	39.03
AUG 3	44819	0.86	42.86	37.30	40.84	38.95
AUG 13	44829	0.77	42.82	37.25	40.81	38.94
AUG 23	44839	0.73	42.79	37.19	40.78	38.94
SEP 2	44849	0.70	42.73	37.12	40.74	38.93
SEP 12	44859	0.66	42.70	37.04	40.68	38.89
SEP 22	44869	0.58	42.64	36.94	40.58	38.84
OCT 2	44879	0.57	42.60	36.88	40.54	38.84
OCT 12	44889	0.54	42.53	36.83	40.50	38.84
OCT 22	44899	0.48	42.43	36.75	40.44	38.80
NOV 1	44909	0.43	42.37	36.70	40.38	38.76
NOV 11	44919	0.38	42.30	36.61	40.30	38.70
NOV 21	44929	0.32	42.25	36.53	40.22	38.61
DEC 1	44939	0.24	42.18	36.50	40.16	38.54
DEC 11	44949	0.22	42.15	36.46	40.12	38.49
DEC 21	44959	0.20	42.13	36.43	40.08	38.44
DEC 31	44969	0.24	42.22	36.50	40.13	38.48

See notes, p. B-32.

NOTES

(1) The primary frequency standard CS 1 of PTB, operating continuously as a clock during 1981, produces a scale of proper time. The time scale under the headline PTB CS 1 is a coordinate time scale at sea level derived from this scale of proper time applying a gravitational frequency correction of -0.00066 µs/d. To ensure the continuity, a correction (time step) of 361.400 µs has to be added to the values published in the former Annual Reports.

(2) The time scales under the headline NRC CsV, Cs VI A, Cs VI B, Cs VI C are the scales of proper time PT(NRC CsV), PT(NRC Cs VI A), PT(NRC Cs VI B), PT(NRC Cs VI C) produced directly by the primary frequency standards Cs V, Cs VI A, Cs VI B, Cs VI C of NRC used as clocks. The gravitational frequency correction to these time scales of proper time to obtain coordinate times at sea level is -0.00097 µs/d.

(3) The NBS-4 primary frequency standard operated as a clock in 1981. However the uses of NBS-4 as a clock and as a standard are distinct from each other.

TABLE 17 - COORDINATED UNIVERSAL TIME

UTC(I) DENOTES THE APPROXIMATION TO UTC KEPT BY THE LABORATORY I

UNIT IS ONE MICROSECOND

DATE 1981	MJD	UTC - UTC(I) AOS (1)	APL	ASMW	AUS (2)	BEV (3)	CAO	CSAO* (4)
JAN 5	44609	-2.13	2.24	1.40	6.7	2.77		-3.0
JAN 15	44619	-2.86	2.24	1.50	6.8	3.44		-2.9
JAN 25	44629	-4.16	2.01	1.63	6.8	4.14		-2.8
FEB 4	44639	-5.45	1.96	1.46	5.8	4.47		-2.5
FEB 14	44649	-6.58	1.87	1.43	5.8	5.08		-2.1
FEB 24	44659	-6.83	1.75	1.47	5.9	5.71		-2.1
MAR 6	44669	-7.08	1.82	1.44	6.1	6.14		-1.6
MAR 16	44679	-7.71	1.81	1.31	6.2	6.64		-1.3
MAR 26	44689	-8.03	1.74	1.22	6.2	7.27		-1.1
APR 5	44699	-8.73	1.68	1.04	6.2	-7.13		-1.0
APR 15	44709	-9.64	1.59	0.97	6.3	-6.61		-0.7
APR 25	44719	-10.37	1.63	1.12	6.4	-6.07		-1.0
MAY 5	44729	-11.27	1.61	1.28	6.6	-5.41		-1.4
MAY 15	44739	-12.28	1.58	1.30	6.7	-4.69		-1.8
MAY 25	44749	-13.29	1.53	1.28	6.8	-3.92		-1.9
JUN 4	44759	-1.11	1.57	1.19	3.8	-3.18		-1.8
JUN 14	44769	-0.90	1.65	1.05	3.8	-2.50		-2.1
JUN 24	44779	-0.44	1.73	0.88	3.9	-1.74		-2.5
JUL 4	44789	-0.39	1.68	0.74	3.9	-1.08		-2.4
JUL 14	44799	-0.17	1.69	0.50	3.9	-0.21		-1.9
JUL 24	44809	0.23	1.71	0.21	3.9	1.05		-1.8
AUG 3	44819	0.31	1.63	0.06	3.9			-1.9
AUG 13	44829	0.69	1.64	-0.19	3.9			-1.9
AUG 23	44839	1.02	1.52	-0.33	4.0			-2.0
SEP 2	44849	1.43	1.50	-0.47	4.0			-2.2
SEP 12	44859	1.91	1.54	-0.72	4.1			-2.5
SEP 22	44869	2.33	1.56	-0.88	4.1			-3.0
OCT 2	44879	2.84	1.54	-1.06	4.2	5.05		-3.1
OCT 12	44889	3.47	1.68	-1.16	4.3	5.49		-3.4
OCT 22	44899	4.34	1.73	-1.18	4.3	6.05		-4.2
NOV 1	44909	4.82	1.86	-1.15	1.1	6.63		-4.3
NOV 11	44919	5.56	2.08	-1.10	1.1	7.39	-0.71	-4.3
NOV 21	44929	6.41	2.24	-1.06	1.1	8.04	-1.19	-4.1
DEC 1	44939	7.02	2.35	-1.11	1.1	8.53	-0.99	-3.4
DEC 11	44949	7.66	2.49	-1.05	1.1	-8.88	-1.04	-3.4
DEC 21	44959	9.10	2.52	-0.80	1.1	-8.42	-1.11	-3.7
DEC 31	44969	9.67	2.50	-0.51	1.1	-8.29	-1.07	-4.0

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1981	MJD	UTC - UTC(I) DHI	FTZ	IEN	IFAG (5)	IGMA (6)	ILOM* (7)	NBS
JAN 5	44609	-0.99		-10.90	-13.29	-10	-47.2	0.32
JAN 15	44619	-1.01		-10.48	-13.36	-9	-15.7	0.34
JAN 25	44629	-0.83		-10.31	-13.43	-10	-17.9	0.44
FEB 4	44639	-0.77		-10.05	-13.81	-11	-19.6	0.79
FEB 14	44649	-0.67		-9.76	-13.92	-10	-21.4	0.75
FEB 24	44659	-0.58		-9.72	-13.90	-12		0.63
MAR 6	44669	-0.42		-9.92	-14.29	-11	-25.2	0.61
MAR 16	44679	-0.29		-9.95	-14.75	-10	-26.7	0.80
MAR 26	44689	-0.04		-9.95	-15.03	-9	-28.6	0.82
APR 5	44699	0.14		-9.94	-15.44	-9	-30.9	0.94
APR 15	44709	0.29		-10.09	-15.67	-9	-32.1	1.00
APR 25	44719	0.24		-10.11	-15.84	-10	-34.0	1.13
MAY 5	44729	0.25		-9.98	-16.18	-10	-36.2	1.13
MAY 15	44739	0.32		-9.95	-16.64	-10	-38.1	1.15
MAY 25	44749	0.44		-10.12	-17.05	-8	-39.4	1.13
JUN 4	44759	0.70		-10.07	-17.48	-7	-40.9	1.14
JUN 14	44769	0.89		-10.20	-17.96	-5	-42.9	1.17
JUN 24	44779	0.93	-7.85	-10.28	-18.20	-3	-44.8	0.37
JUL 4	44789	0.89	-7.84	-10.26	-18.69	-3	-46.2	0.34
JUL 14	44799	0.81	-7.90	-10.17	-19.10	-5	-47.2	0.29
JUL 24	44809	0.62	-7.97	-10.03	-19.69	-5	-48.7	0.26
AUG 3	44819	0.64	-7.97	-9.94	-20.30	-3	-50.0	0.21
AUG 13	44829	0.48	-7.90	-9.94	-20.70	-5	-51.3	0.19
AUG 23	44839	0.25	-7.93	-9.85	-20.15	-4	-52.8	0.16
SEP 2	44849	0.14	-7.95	-9.77	-20.49	-7	-54.3	0.17
SEP 12	44859	0.05	-7.94	-9.66	-21.09	-6	-56.2	0.14
SEP 22	44869	-0.03	-7.87	-9.38	-21.77	-5	-58.0	0.13
OCT 2	44879	-0.18	-7.84	-9.48	-22.44	-4	-59.5	0.11
OCT 12	44889	-0.36	-7.84	-9.49	-23.02	0	-61.1	0.11
OCT 22	44899	-0.53	-7.78	-9.22	-23.58	0	-62.8	0.05
NOV 1	44909	-0.67	-7.72	-9.27	-24.23	2	-64.4	0.02
NOV 11	44919	-0.96	-7.69	-9.34	-24.84	2	-66.1	-0.03
NOV 21	44929	-1.15	-7.62	-9.21	-25.61	6	-67.9	-0.08
DEC 1	44939	-1.31	-7.56	-9.18	-26.32	6	-68.9	-0.15
DEC 11	44949	-1.43	-7.48	-9.43	-27.04	1	-70.3	-0.13
DEC 21	44959	-1.58	-7.42	-9.56	-27.52	4	-72.1	-0.12
DEC 31	44969	-1.55	-7.31	-9.69	-28.38	4	-73.9	-0.13

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1981	MJD	UTC - UTC(I) NIM* (8)	NPL	NPRL (9)	NRC	NRLM*	OAB	OMH (10)
JAN 5	44609	-6.8	5.75	17	-8.20	-74.4	-122.19	
JAN 15	44619	-7.1	5.58	16	-8.18	-73.7	-123.86	
JAN 25	44629	-7.6	5.48	17	-8.07	-73.2	-125.83	
FEB 4	44639	-8.0	5.39	18	-8.06	-72.6	-127.88	
FEB 14	44649	-8.4	5.26	16	-7.96	-72.0	-129.84	
FEB 24	44659	-8.5	5.25	17	-7.89	-71.4	-131.67	
MAR 6	44669	-8.8	5.13	19	-7.85	-70.5	-133.73	
MAR 16	44679	-9.2	5.16	19	-7.78	-69.9	-135.76	
MAR 26	44689	-9.6	5.18	20	-7.70	-69.3	-137.70	
APR 5	44699	-10.6	5.18	21	-7.64	-69.3	-139.65	
APR 15	44709	-10.4	5.22	21	-7.55	-68.2	-141.76	
APR 25	44719	-11.2	4.90	18	-7.51	-68.0	-143.86	
MAY 5	44729	-11.8	4.96	18	-7.48	-67.7	-145.87	
MAY 15	44739	-12.1	4.96	21	-7.44	-67.2	-147.78	1.32
MAY 25	44749	-11.8	5.02	18	-7.41	-66.1	-149.88	1.28
JUN 4	44759	-11.5	4.98	18	-7.42	-65.1	-151.40	1.39
JUN 14	44769	-11.9	4.99	18	-7.39	-64.6	-152.08	1.59
JUN 24	44779	-12.3	4.98	19	-7.38	-64.1	-152.80	1.57
JUL 4	44789	-12.4	4.99	17	-7.39	-63.3	-153.40	1.37
JUL 14	44799	-12.1	5.07	14	-7.44	-62.0	-153.87	1.15
JUL 24	44809	-12.1	4.96	11	-7.45	-61.2	-154.23	0.73
AUG 3	44819	-12.2	4.97	6	-7.56	-60.7	-154.60	0.90
AUG 13	44829	-12.1	4.96	16	-7.59	-60.2	-155.15	-0.01
AUG 23	44839	-12.3	4.89	23	-7.60	-59.8	-155.71	-0.04
SEP 2	44849	-12.5	5.02	25	-7.65	-59.5	-156.30	-0.25
SEP 12	44859	-12.6	5.15	27	-7.68	-59.3	-156.76	-0.33
SEP 22	44869	-12.6	5.08	25	-7.73	-59.2	-157.04	-0.40
OCT 2	44879	-12.2	5.07	25	-7.76	-58.8	-157.37	0.34
OCT 12	44889	-12.1	5.01	21	-7.82	-58.5	-157.71	0.25
OCT 22	44899	-12.2	4.83	15	-7.90	-58.3	-158.04	0.58
NOV 1	44909	-12.2	4.77	18	-7.96	-58.0	-158.47	-0.23
NOV 11	44919	-12.6	4.65	17	-8.02	-57.4	-159.08	-0.75
NOV 21	44929	-12.5	4.62	16	-8.06	-56.8	-159.55	-0.53
DEC 1	44939	-11.8	4.62	15	-8.12	-55.5	-159.91	-0.33
DEC 11	44949	-11.9	4.41	16	-8.14	-54.4	-160.39	-0.20
DEC 21	44959	-11.9	4.00	11	-8.15	-54.0	-160.85	-0.41
DEC 31	44969	-11.9	3.97	14	-8.05	-53.4	-161.27	-0.67

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1981	MJD	UTC - UTC(I) OMSF	ON	OP	ORB	PKNM	PTB	PTCH
JAN 5	44609	-1.31	13.42	1.01	10.73	-0.18	0.59	-3.11
JAN 15	44619	-1.31	13.39	1.02	10.24	-0.19	0.60	-3.46
JAN 25	44629	-1.44	13.35	1.07	9.85	-0.03	0.69	-3.70
FEB 4	44639	-1.37	13.23	0.98	9.50	-0.16	0.63	-4.10
FEB 14	44649	-1.38	13.14	0.92	9.02	-0.03	0.67	-4.44
FEB 24	44659	-1.33	13.15	0.85	8.51	0.05	0.75	-4.53
MAR 6	44669	-1.53	12.92	0.72	8.50	0.23	0.83	-5.01
MAR 16	44679	-1.51	12.75	0.71	8.13	0.15	0.83	-5.52
MAR 26	44689	-1.51	12.72	0.70	7.89	0.04	0.98	-6.05
APR 5	44699	-1.34	12.52	0.59	7.35	-0.11	1.00	-6.83
APR 15	44709	-1.44	12.29	0.56	7.54	-0.06	1.07	-7.48
APR 25	44719	-1.31	12.10	0.42	6.93	-0.25	1.09	-7.87
MAY 5	44729	-1.40	12.10	0.29	6.65	-0.54	1.12	-8.47
MAY 15	44739	-1.24	11.99	0.27	6.33	-0.95	1.08	-9.20
MAY 25	44749	-1.14	11.96	0.20	6.38	-1.22	1.10	-9.77
JUN 4	44759	-1.30	11.94	0.17	6.11	-1.49	1.07	-10.81
JUN 14	44769	-1.41	11.86	0.15	6.05	-1.73	1.09	-11.69
JUN 24	44779	-1.57	11.85	0.15	5.83	-1.97	1.06	-12.19
JUL 4	44789	-1.56	11.86	0.07	5.54	-2.16	1.03	-12.94
JUL 14	44799	-1.54	11.84	0.02	5.34	-2.23	0.98	-13.87
JUL 24	44809	-1.56	11.85	-0.07	5.46	-2.46	0.86	-14.75
AUG 3	44819	-1.50	11.94	-0.07	5.06	-2.70	0.85	-15.90
AUG 13	44829	-1.54	11.92	-0.08	4.18	-2.89	0.77	-17.14
AUG 23	44839	-1.52	11.83	-0.16	3.62	-2.92	0.73	-18.13
SEP 2	44849	-1.67	11.83	-0.18	3.40	-3.05	0.70	-19.02
SEP 12	44859	-1.77	11.81	-0.23	3.33	-3.22	0.65	-19.93
SEP 22	44869	-1.78	11.89	-0.31	3.10	-3.48	0.58	-20.88
OCT 2	44879	-1.82	11.89	-0.32	3.20	-3.72	0.57	-21.63
OCT 12	44889	-1.82	11.95	-0.39	2.68	-3.89	0.54	-22.30
OCT 22	44899	-1.69	12.11	-0.49	2.43	-4.01	0.48	-22.93
NOV 1	44909	-1.53	12.21	-0.52	1.28	-3.97	0.45	-23.50
NOV 11	44919	-1.66	12.21	-0.57	1.89	-3.85	0.38	-23.84
NOV 21	44929	-1.57	12.22	-0.64	1.51	-3.74	0.32	-24.68
DEC 1	44939	-1.57	12.26	-0.71	1.25	-3.59	0.24	-25.09
DEC 11	44949	-1.59	12.15	-0.80	1.09	-3.20	0.22	-25.55
DEC 21	44959	-1.41	12.17	-0.95	0.75	-2.88	0.19	-26.26
DEC 31	44969	-1.47	12.21	-0.98	0.49	-2.72	0.25	-26.84

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1981	MJD	UTC - UTC(I) RGO	RRL*	SO * (11)	STA (12)	SU (13)	TAO *	TL*
JAN 5	44609	-3.93	-6.6	-1.7	-0.22	17.4	-2.7	49.1
JAN 15	44619	-4.03	-6.6	-2.2	-0.17	17.4	-2.6	49.5
JAN 25	44629	-4.15	-6.6	-2.7	-0.08	17.1	-2.7	50.9
FEB 4	44639	-4.22	-6.5	-2.1	-0.07	18.8	-2.7	51.2
FEB 14	44649	-4.31	-6.4	-1.6	0.04	19.5	-2.7	50.6
FEB 24	44659	-4.37	-7.4	-1.3	0.01	19.6	-4.6	51.2
MAR 6	44669	-4.40	-7.1	-1.4	0.16	21.2	-4.0	51.0
MAR 16	44679	-4.60	-7.0	-1.8	0.55	20.8	-4.1	49.7
MAR 26	44689	-4.57	-6.9	-1.4	0.63	18.2	-4.1	48.8
APR 5	44699	-4.58	-5.9	-1.9	0.49	18.5	-3.3	50.3
APR 15	44709	-4.63	-5.2	-2.3	0.56	19.6	-2.9	50.2
APR 25	44719	-4.73	-5.5	-3.4	0.60	19.3	-3.3	49.4
MAY 5	44729	-4.82	-5.6	-3.9	0.72	19.0	-3.7	47.8
MAY 15	44739	-4.85	-5.6	-3.8	0.84	19.1	-3.8	47.5
MAY 25	44749	-5.02	-5.2	-4.2	0.91	20.0	-3.5	47.1
JUN 4	44759	-5.15	-4.7	-3.9	1.01	20.8	-3.3	46.9
JUN 14	44769	-5.27	-4.9	-3.8	1.14	20.3	-3.6	46.4
JUN 24	44779	-5.36	-5.0	-3.9	1.08	19.3	-3.9	45.8
JUL 4	44789	-5.48	-4.7	-4.1	1.28	19.6	-3.9	45.4
JUL 14	44799	-5.67	-4.2	-4.1	1.58	20.3	-3.6	45.5
JUL 24	44809	-5.88	-4.0	-4.4	1.47	20.8	-3.6	45.1
AUG 3	44819	-6.00	-3.7	-4.8	1.65	21.2	-3.8	44.1
AUG 13	44829	-6.09	-3.4	-4.7	1.53	21.6	-3.6	43.4
AUG 23	44839	-6.32	-3.3	-4.8	1.31	21.7	-3.7	43.2
SEP 2	44849	-6.56	-3.2	-4.9	1.15	22.0	-3.7	42.8
SEP 12	44859	-6.73	-3.4	-5.1	0.89	21.8	-4.0	41.7
SEP 22	44869	-6.95	-3.6	-4.9	0.72	21.6	-4.3	40.7
OCT 2	44879	-7.15	-3.5	-4.5	0.37	21.9	-4.3	40.6
OCT 12	44889	-7.38	-3.5	-4.4	0.15	22.1	-4.5	40.9
OCT 22	44899	-7.61	-3.7	-4.4	-0.12	22.4	-4.7	39.9
NOV 1	44909	-7.79	-3.7	-4.1	-0.45	22.6	-4.9	39.2
NOV 11	44919	-8.01	-3.9	-5.1	-0.76	22.7	-5.2	39.2
NOV 21	44929	-7.94	-3.9	-5.9	-0.90	23.1	-5.3	38.0
DEC 1	44939	-8.20	-3.4	-5.5	-1.05	22.9	-4.9	38.6
DEC 11	44949	-8.52	-3.3	-5.4	-1.06	23.0	-5.0	39.3
DEC 21	44959	-8.89	-3.5	-6.1	-1.25	23.0	-5.3	40.3
DEC 31	44969	-9.19	-3.6	-6.1	-1.13	23.4	-5.5	38.9

TABLE 17 - (CONT.)

UNIT IS ONE MICROSECOND

DATE 1981	MJD	UTC - UTC(I) TP	TUG (14)	USNO	VSL	ZIPE
JAN 5	44609	-1.15	3.65	0.93	1.06	1.42
JAN 15	44619	-1.33	3.19	0.92	1.05	1.50
JAN 25	44629	-1.34	2.68	0.79	1.13	1.70
FEB 4	44639	-1.32	1.94	0.83	1.16	1.81
FEB 14	44649	-1.22	1.44	0.76	1.16	1.84
FEB 24	44659	-1.27	1.00	0.70	1.14	1.82
MAR 6	44669	-1.30	0.35	0.79	1.22	1.83
MAR 16	44679	-1.09	-0.27	0.75	1.21	2.06
MAR 26	44689	-0.62	-0.81	0.63	1.43	2.65
APR 5	44699	-0.09	-1.38	0.56	1.52	2.94
APR 15	44709	0.84	-1.97	0.55	1.69	2.71
APR 25	44719	1.38	-2.49	0.57	1.80	2.22
MAY 5	44729	1.65	-3.04	0.58	1.87	1.89
MAY 15	44739	1.65	-3.66	0.57	2.04	1.80
MAY 25	44749	1.65	4.80	0.56	2.26	1.70
JUN 4	44759	1.73	4.19	0.59	2.45	1.82
JUN 14	44769	1.93	3.67	0.62	2.61	1.83
JUN 24	44779	2.08	3.08	0.72	2.72	1.85
JUL 4	44789	1.89	2.52	0.73	2.76	1.97
JUL 14	44799	1.60	1.89	0.79	2.77	2.18
JUL 24	44809	1.23	1.26	0.88	2.68	2.29
AUG 3	44819	1.11	0.68	0.89	2.83	1.54
AUG 13	44829	0.55	0.02	0.98	2.85	1.18
AUG 23	44839	0.31	-0.59	1.08	2.83	0.96
SEP 2	44849	-0.15	-1.17	1.18	2.85	0.25
SEP 12	44859	-0.23	-1.81	1.30	2.92	-0.08
SEP 22	44869	0.07	-2.44	1.37	2.92	-0.25
OCT 2	44879	0.21	-3.03	1.49	2.77	-0.25
OCT 12	44889	0.26	-3.62	1.62	2.56	-0.58
OCT 22	44899	0.14	-4.19	1.68	2.43	-0.63
NOV 1	44909	-0.14	-4.77	1.76	2.41	-0.38
NOV 11	44919	-0.41	-5.29	1.82	2.45	-0.05
NOV 21	44929	-0.48	-5.87	1.86	2.51	0.48
DEC 1	44939	-0.39	5.59	1.89	2.59	0.88
DEC 11	44949	-0.50	5.00	1.98	2.58	0.57
DEC 21	44959	-0.78	4.56	2.03	2.44	-0.48
DEC 31	44969	-0.63	3.93	2.02	2.46	-0.19

TABLE 17 - (CONT.)

NOTES

In general, the uncertainties are of the order of ten times larger than the unit of the last reported digit. See Table 18.

(1) AOS. A time step of UTC(AOS) of -12.600 μs was made by AOS on 1981 June 1.

(2) AUS. The UTC-UTC(AUS) are directly computed from the predicted values UTC(USNO MC)-UTC(AUS) of Bulletin E of DNM. Time steps in the UTC-UTC(AUS) values reflect that clock transportation results were taken into account by DNM.

(3) BEV. Time steps of UTC(BEV) of +15.00 and +17.50 μs were made by BEV respectively on 1981 April 3 and December 1. From 1981 August 1 till 1981 September 30, no clock was available at BEV.

(4) CSAO. The origin of UTC-UTC(CSAO) was fixed by the clock transportation result between USNO and CSAO on 1981 August 28. The values UTC-UTC(CSAO) published in the BIH Annual Report for 1980 have to be corrected by -5.2 μs.

(5) IFAG. A time correction was introduced starting from MJD = 44832 to take into account the clock transportation result between PTB and IFAG on 1981 October 6.

(6) IGMA. Results obtained by VLF. The clock transportation results between IGMA and ONBA, USNO and ONBA end November 1979 fixed the origin from MJD = 44109.

(7) ILOM. Change of master clock on 1981 January 15.

(8) NIM. The origin of UTC-UTC(NIM)was fixed by the clock transportation result between NIM and OP on 1981 May 15. The values UTC-UTC(NIM) published in the BIH Annual Report for 1980 have to be corrected by -4.5 μs.

(9) NPRL. Results obtained by VLF. The origin was given by a clock transportation on 1974 April 9.

(10) OMH. No clock available till 1981 May 5.

(11) SO. The origin of UTC-UTC(SO) was improved by the clock transportation result between USNO and SO on 1981 August 24. The values UTC-UTC(SO) published in the BIH Annual Report for 1980 have to be corrected by - 1.27 μs.

Values in μs of UTC-UTC(SO) from MJD = 44329 till MJD = 44599

MJD	UTC-UTC(SO)	MJD	UTC-UTC(SO)	MJD	UTC-UTC(SO)
44 329	- 0.1	44 429	- 2.4	44 529	- 1.0
44 339	- 0.7	44 439	- 2.3	44 539	- 1.0
44 349	- 0.7	44 449	- 2.1	44 549	- 0.3
44 359	- 0.4	44 459	- 1.8	44 559	- 0.4
44 369	- 1.6	44 469	- 1.7	44 569	- 0.5
44 379	- 1.6	44 479	- 1.5	44 579	- 0.3
44 389	- 1.1	44 489	- 1.4	44 589	- 0.2
44 399	- 2.3	44 499	- 1.2	44 599	- 0.6
44 409	- 1.8	44 509	- 1.3		
44 419	- 2.1	44 519	- 1.1		

(12) STA. A time step of UTC(STA) of - 26.6 μs was made by STA on 1981 January 1.

TABLE 17 - (CONT.)

(13) SU. UTC-UTC(SU) was computed using the Northwest Pacific chain of LORAN-C except during the intervals 44659-44689 and 44939-44969 where respectively the GBR signal and the TV link between TP and SU were used.

(14) TUG. Time steps of UTC(TUG) of -9.00 μs and -12.0 μs were made by TUG respectively on 1981 May 20 and November 25.

* CSAO, ILOM, NIM, NRLM, RRL, SO, TAO, TL. From MJD = 44659 to MJD = 44689, the LORAN-C reception of Iwo-Jima was replaced by the LORAN-C reception of Marcus. The apparent steps are due to the time link and not to the local clocks.

TABLE 18 - COMPARISONS BETWEEN THE CLOCK TRANSPORTATIONS AND THE BIH RESULTS

THE TABLE GIVES THE DIFFERENCES BETWEEN THE CLOCK TRANSPORTATION RESULTS AND THOSE DERIVED FROM THE DATA OF TABLE 17 (BEFORE ROUNDING-OFF)

DATE		MJD	TIME COMPARISONS	DIFFERENCE CLOCK TR. - BIH (UNIT : 1 MICROSECOND)
1981				
JAN	26	44630.5	UTC(USNO) - UTC(NRC)	0.4
JAN	30	44634.5	UTC(NBS) - UTC(USNO)	0.4
MAR	25	44688.6	UTC(PTB) - UTC(IFAG)	0.796
APR	9	44703.8	UTC(NBS) - UTC(USNO)	0.55
APR	17	44711.1	UTC(USNO) - UTC(NBS)	-0.65
APR	22	44716.4	UTC(USNO) - UTC(PTB)	0.1
APR	23	44717.3	UTC(USNO) - UTC(DHI)	0.7
APR	24	44718.6	UTC(USNO) - UTC(IFAG)	0.9
APR	28	44722.3	UTC(USNO) - UTC(TUG)	0.4
APR	28	44722.6	UTC(USNO) - UTC(BEV)	0.3
APR	29	44723.5	UTC(USNO) - UTC(ON)	1.1
MAY	5	44729.5	UTC(USNO) - UTC(RGO)	0.3
MAY	6	44730.3	UTC(USNO) - UTC(NPL)	-0.1
MAY	15	44739.0	UTC(NIM) - UTC(OP)	0.0*
MAY	18	44742.0	UTC(TAO) - UTC(RRL)	-0.10
MAY	18	44742.99	UTC(TAO) - UTC(NRLM)	0.16
MAY	27	44751.99	UTC(NBS) - UTC(USNO)	0.75
JUN	2	44757.3	UTC(USNO) - UTC(OP)	0.15
JUN	3	44758.0	UTC(TAO) - UTC(ILOM)	0.22
JUN	3	44758.4	UTC(USNO) - UTC(ORB)	-0.39
JUN	4	44759.2	UTC(USNO) - UTC(VSL)	-0.15
JUN	11	44766.4	UTC(USNO) - UTC(NPL)	-0.28
JUL	24	44809.9	UTC(USNO) - UTC(NBS)	0.057
JUL	28	44813.6	UTC(USNO) - UTC(NBS)	0.03
AUG	4	44820.4	UTC(USNO) - UTC(NRC)	-0.09
AUG	21	44837.1	UTC(USNO) - UTC(RRL)	-0.7
AUG	23	44839.2	UTC(USNO) - UTC(TAO)	-0.7
AUG	24	44840.4	UTC(USNO) - UTC(SO)	0.0*
AUG	28	44844.2	UTC(USNO) - UTC(CSAO)	0.0*
SEP	1	44848.1	UTC(NBS) - UTC(USNO)	0.006
SEP	9	44856.3	UTC(ILOM) - UTC(RRL)	0.1
OCT	6	44883.8	UTC(PTB) - UTC(IFAG)	0.0*
OCT	9	44886.4	UTC(NBS) - UTC(OP)	0.23
OCT	14	44891.6	UTC(TP) - UTC(OMH)	-0.3
OCT	19	44896.0	UTC(TAO) - UTC(RRL)	0.10
OCT	20	44897.0	UTC(TAO) - UTC(NRLM)	0.11
OCT	22	44899.4	UTC(NBS) - UTC(OP)	0.38
OCT	27	44904.0	UTC(TAO) - UTC(ILOM)	0.03
NOV	6	44914.6	UTC(USNO) - UTC(NBS)	0.05
NOV	17	44925.5	UTC(PKNM) - UTC(ASMW)	-0.282
DEC	1	44939.2	UTC(NBS) - UTC(USNO)	-0.02
DEC	9	44947.5	UTC(PKNM) - UTC(SU)	0.042

COMPLEMENTARY RESULTS FOR THE PREVIOUS YEAR

1980				
APR	10	44339.3	UTC(ILOM) - UTC(RRL)	0.0
AUG	19	44470.3	UTC(ILOM) - UTC(RRL)	-0.1
NOV	13	44556.3	UTC(ILOM) - UTC(RRL)	0.0

* NEW ORIGIN _ SEE TABLE 17

TABLE 19 - INTERNATIONAL ATOMIC TIME , BI-MONTHLY RATES OF TAI-CLOCK FOR 1981

THE RATES ARE AVERAGED OVER INTERVALS OF TWO MONTHS ENDING AT THE GIVEN DATES

UNIT IS NS/DAY , 0.0 DENOTES THAT THE CLOCK WAS NOT USED

LAB.	CLOCK	44659	44719	44779	44839	44899	44969
AOS	19 7	-96.05	-59.90	-49.61	25.03	53.45	78.14
APL	14 121	-101.17	-109.83	-112.64	-107.83	-105.47	-90.62
APL	14 773	57.10	53.91	45.07	35.26	43.86	64.92
APL	14 793	183.80	189.62	194.23	190.29	196.57	204.93
ASMW	16 76	2.03	-9.98	-21.26	-50.69	-45.34	-19.35
ASMW	16 165	-19.62	-29.47	-23.76	-28.79	-25.13	-24.97
ASUA	16 69	0.0	114.43	0.0	0.0	-56.32	-53.15
ASUA	16 77	-78.27	-91.92	0.0	0.0	-102.10	-106.76
ASUA	17 206	56.71	66.62	0.0	0.0	-6.79	-3.09
ASUA	17 208	-180.34	-201.79	0.0	0.0	-225.70	-228.40
ASUA	99 1	13.89	15.06	0.0	0.0	91.25	94.68
ASUA	99 2	320.72	321.52	0.0	0.0	111.70	115.68
ASUA	99 4	6.98	0.0	0.0	0.0	-4.62	-8.92
ASUA	99 5	-36.07	-68.80	0.0	0.0	-162.32	-165.13
BEV	16 71	58.92	54.91	72.64	0.0	0.0	45.92
F	12 133	52.59	119.24	245.23	488.81	0.0	0.0
F	12 158	0.0	0.0	-54.41	-68.10	-73.22	-74.82
F	12 195	221.32	215.99	225.65	227.63	230.16	0.0
F	12 206	13.96	0.56	13.89	9.46	-2.55	11.80
F	12 347	-46.62	-36.00	-30.93	-34.23	-37.59	-47.74
F	12 439	-39.78	-40.55	-54.07	-65.19	-61.20	-46.94
F	14 500	0.0	0.0	0.0	0.0	-51.37	-54.31
F	14 594	0.0	0.0	-240.24	-241.68	-243.67	-249.09
F	14 753	0.0	-69.61	-75.34	-70.16	-66.71	-55.56
F	16 80	-110.41	-107.98	-114.04	0.0	0.0	0.0
F	22 120	-11.32	-3.04	-6.44	-8.14	-11.99	-4.89
F	24 407	-149.99	-144.99	-150.12	-139.41	-143.78	-147.20
F	24 645	-68.02	-58.32	-46.30	-42.20	-40.55	-45.83
F	24 712	0.0	-44.69	-42.81	-43.28	-43.89	-46.00
FTZ	14 312	0.0	0.0	0.0	15.64	1.32	-0.93
FTZ	14 895	0.0	0.0	0.0	1.26	1.69	6.39
FTZ	16 130	0.0	0.0	0.0	7.06	13.33	20.70
FTZ	24 217	0.0	0.0	0.0	-0.32	1.70	6.47
FTZ	24 482	0.0	0.0	0.0	-1.06	-1.88	1.44
FTZ	24 656	0.0	0.0	0.0	-9.97	-8.79	-3.93
IEN	12 303	-41.88	-45.91	-51.10	-38.40	-45.29	-59.46
IEN	12 469	-35.36	-22.97	0.0	0.0	25.91	0.0
IEN	12 609	-98.67	-105.56	-104.05	-92.44	-90.98	-106.13
IEN	14 893	42.33	35.20	35.81	41.15	39.74	30.65
IEN	16 84	0.0	146.72	129.98	123.67	124.86	146.69

TABLE 19 - (CONT.)

LAB.	CLOCK	44659	44719	44779	44839	44899	44969
IFAG	16 131	172.66	152.63	0.0	0.0	0.0	53.44
IFAG	16 138	-13.99	-33.05	-40.95	-47.32	-59.56	-68.32
IFAG	16 173	178.84	219.61	245.57	0.0	0.0	0.0
NBS	11 137	-38.58	-64.23	0.0	-65.46	-76.50	-66.80
NBS	11 167	-550.14	-556.45	-561.97	-558.77	-548.25	-545.92
NBS	12 352	-595.43	-582.25	-605.48	-621.41	-611.74	-597.75
NBS	14 316	-20.81	-11.06	-21.80	-22.58	-14.60	-10.39
NBS	14 323	0.0	-114.46	-110.77	-107.42	-103.79	0.0
NBS	14 601	0.0	0.0	0.0	-43.54	-43.78	-42.40
NBS	18 8	938.76	935.27	921.30	932.73	940.41	938.95
NBS	22 375	121.13	120.65	131.16	134.31	127.44	72.48
NBS	91 4	0.0	6.19	0.0	0.0	0.0	0.0
NPL	12 316	-24.68	-68.13	-133.80	-129.44	-107.86	-139.53
NPL	12 418	-68.15	-61.72	-57.65	-60.26	-59.76	-71.33
NPL	12 832	196.74	204.09	197.25	190.56	191.31	228.87
NPL	14 334	-120.18	-112.61	-124.11	-123.86	-124.94	0.0
NRC	12 122	-453.38	-493.16	0.0	0.0	0.0	0.0
NRC	14 267	-23.83	-23.64	-27.95	-21.08	-19.53	-19.70
NRC	90 5	5.08	5.79	1.20	-5.15	-5.69	-3.81
NRC	90 61	0.49	1.43	-0.38	-6.86	-7.37	-4.32
NRC	90 62	4.63	1.93	-0.13	-4.26	-5.80	-5.09
NRC	90 63	10.52	-0.14	2.28	-0.88	-2.39	-5.40
OAB	16 144	0.0	0.0	0.0	-46.22	-37.23	-46.17
OAB	16 146	-190.86	-201.90	-153.14	0.0	0.0	0.0
OMH	22 67	0.0	0.0	0.0	-28.01	12.68	-9.36
OMSF	14 896	-2.06	1.54	-3.06	0.87	-3.07	2.79
OMSF	16 113	25.69	9.66	1.86	14.34	0.80	16.52
OMSF	16 121	0.0	0.0	0.0	-28.94	-42.71	-59.00
OMSF	16 177	28.29	34.32	22.23	29.71	17.44	14.83
OMSF	22 223	184.49	179.57	188.42	189.27	194.57	201.23
OMSF	24 569	30.71	86.06	0.0	0.0	0.0	0.0
ON	12 285	-9.87	-24.09	-24.44	-26.19	-22.38	-19.63
ON	12 863	-1.30	-18.01	-5.01	-7.58	-2.41	-0.56
ON	13 14	19.71	5.95	5.14	5.98	-0.65	5.09
ON	16 114	-7.96	-9.72	-14.58	0.0	0.0	0.0
ON	24 156	-15.15	-17.65	-8.32	0.0	0.0	0.0
ON	24 796	0.0	0.0	0.0	0.0	-6.05	-18.86
ORB	12 205	-1.58	-3.44	7.20	-25.77	-38.00	-47.30
ORB	12 804	23.01	43.27	53.21	35.63	52.19	28.03
PKNM	16 124	-26.02	-19.34	-21.68	-33.75	-26.04	17.50
PKNM	16 125	39.62	68.26	47.47	46.16	35.20	91.74
PKNM	16 154	-8.98	0.0	0.0	0.0	0.0	0.0
PKNM	24 144	-28.13	-21.88	-21.53	-18.40	-22.43	-22.91
PTB	12 320	8.39	0.0	0.0	0.0	0.0	0.0
PTB	12 389	0.0	-105.13	-105.36	-114.55	-120.48	-143.44

TABLE 19 - (CONT.)

LAB.	CLOCK	44659	44719	44779	44839	44899	44969
PTB	12 462	-1.91	-7.08	-7.34	-6.63	0.78	-38.78
PTB	14 394	-52.22	-47.28	-46.76	-47.96	-46.51	-51.52
PTB	14 395	-64.55	-61.80	-62.12	-61.88	-55.86	-52.82
PTB	14 867	-201.02	-199.42	-203.21	-207.97	-207.65	-210.76
PTB	16 119	92.15	86.75	76.00	66.70	87.88	100.24
PTB	24 103	-21.25	-17.25	-19.19	-29.69	-31.07	-31.93
PTB	92 1	3.15	5.92	-0.63	-5.77	-4.17	-4.08
PTCH	16 64	-28.22	-58.15	-75.07	-100.83	-80.91	-55.59
PTCH	16 140	81.74	44.13	16.10	-16.43	-1.44	47.35
RGO	11 123	-208.70	-205.03	-193.97	-199.99	-202.32	-196.54
RGO	11 199	-50.53	-57.67	-65.04	-65.73	-66.01	-72.68
RGO	12 348	251.62	181.94	188.29	195.43	192.76	183.77
RGO	14 202	0.0	0.0	-278.56	-288.68	-291.33	-291.72
RGO	14 484	-402.31	-390.91	-359.95	0.0	0.0	0.0
RGO	14 560	-66.68	-66.15	-68.42	-59.75	-80.11	-79.76
RGO	14 868	-132.69	-130.24	-133.08	-137.66	-142.09	-138.43
STA	11 200	-441.60	0.0	0.0	0.0	0.0	0.0
STA	14 900	-134.21	-133.67	-128.51	-129.17	-138.32	-146.66
STA	16 137	-13.68	-15.25	-23.80	-34.26	-27.98	-11.57
STA	24 376	-186.65	-186.33	-183.25	-164.05	-146.50	0.0
TP	12 335	-246.69	-246.13	-259.11	-271.55	-264.18	-290.85
TUG	12 524	0.0	0.0	0.0	162.29	162.06	163.69
TUG	24 654	-52.63	-57.91	-57.22	-61.52	-60.34	-54.96
USNO	12 57	0.0	-289.75	-339.90	-366.07	-395.55	-338.87
USNO	12 58	0.0	0.0	-11.64	-14.83	-31.29	0.0
USNO	12 120	0.0	0.0	86.09	97.72	114.84	130.02
USNO	12 147	-278.06	-267.99	-257.30	-257.27	-263.30	-283.44
USNO	12 150	0.0	0.0	-6.44	-6.59	-10.07	-4.64
USNO	12 532	9.56	16.39	13.35	15.11	14.66	12.33
USNO	12 549	199.02	173.58	170.67	140.16	100.87	-93.79
USNO	12 573	-85.63	-75.54	-51.37	-38.76	-42.88	-80.02
USNO	12 591	201.98	186.45	168.33	150.82	0.0	0.0
USNO	12 752	-151.62	-151.48	-159.23	-156.07	-149.25	-144.13
USNO	12 761	-226.22	-239.71	-233.40	-239.99	0.0	0.0
USNO	12 778	223.45	228.14	230.99	233.82	233.41	225.72
USNO	12 862	-225.42	-219.41	-223.63	0.0	0.0	0.0
USNO	12 873	-88.83	-101.07	-102.77	-98.63	-116.07	-123.48
USNO	14 571	-113.70	-101.40	-95.53	-100.74	-94.88	-99.10
USNO	14 653	-166.84	-176.69	0.0	0.0	0.0	0.0
USNO	14 783	10.31	3.62	12.10	20.26	46.40	30.92
USNO	14 834	-101.23	-99.81	-85.14	-86.32	-85.80	-94.57
USNO	14 871	429.04	432.27	442.53	449.09	0.0	0.0
USNO	14 875	0.0	-77.61	0.0	0.0	0.0	0.0
USNO	16 107	0.0	0.0	0.0	810.03	825.80	833.40
USNO	16 108	0.0	0.0	0.0	0.0	0.0	491.16

TABLE 19 - (CONT.)

LAB.	CLOCK	44659	44719	44779	44839	44899	44969
USNO	16 133	0.0	0.0	0.0	0.0	0.0	-143.19
USNO	16 142	0.0	0.0	0.0	0.0	0.0	-452.54
USNO	22 114	31.50	33.11	36.56	46.06	55.41	65.83
USNO	22 264	0.0	-5.12	3.08	12.43	2.03	45.06
USNO	22 362	0.0	0.0	-237.63	0.0	0.0	-52.14
USNO	22 585	28.18	34.83	36.16	43.06	30.40	0.0
USNO	22 653	-0.70	1.65	0.0	0.0	0.0	0.0
USNO	22 710	-91.89	-80.31	-79.64	-86.05	-84.39	-93.75
USNO	24 25	0.0	0.0	-92.90	-84.45	0.0	0.0
USNO	24 26	0.0	-112.15	-128.42	-92.47	-74.16	-67.60
USNO	24 28	-111.34	-112.13	0.0	0.0	-84.87	-112.27
USNO	24 33	0.0	41.68	53.76	84.58	102.76	102.26
USNO	24 35	-73.73	-75.70	-84.78	-82.45	-83.92	-89.64
USNO	24 117	-76.01	-68.40	-58.86	-56.14	-54.54	-66.79
USNO	24 300	0.0	0.0	0.0	-115.86	0.0	0.0
USNO	24 377	-171.84	-161.31	-139.18	-130.38	-126.38	-129.85
USNO	24 423	-30.56	-23.35	-22.47	-25.10	-24.36	-27.06
USNO	24 449	-181.63	-184.20	-181.95	-184.65	-183.58	0.0
USNO	24 586	-194.17	-180.80	0.0	0.0	0.0	0.0
USNO	24 605	52.48	50.25	0.0	0.0	36.36	34.68
USNO	24 688	-13.55	-14.63	-15.92	-21.24	-17.68	-35.73
USNO	24 846	0.0	0.0	0.0	0.0	0.0	-51.30
VSL	14 503	-249.36	0.0	0.0	-251.32	-250.38	-253.33
VSL	22 34	55.58	65.13	70.46	69.18	60.50	68.42
VSL	22 489	-78.73	-57.93	-47.41	-19.50	0.0	0.0
VSL	24 190	16.01	0.0	26.12	14.36	12.09	0.0
ZIPE	12 979	21.60	100.81	155.64	177.60	188.20	0.0

THE CLOCKS ARE DESIGNATED BY THEIR MODEL (2 DIGITS) AND SERIAL NO.
THE CODES FOR THE MODELS ARE

11	HEWLETT-PACKARD 5060A	
12 AND 22	HEWLETT-PACKARD 5061A	(22 001 EQUIVALENT TO 12 1001)
13	EBAUCHES OSCILLATOM. B 5000	
14 AND 24	HEWLETT-PACKARD 5061A OPT.4	(24 001 EQUIVALENT TO 14 1001)
16 AND 26	OSCILLOQUARTZ 3200	(26 001 EQUIVALENT TO 16 1001)
17 AND 27	OSCILLOQUARTZ 3000	(27 001 EQUIVALENT TO 17 1001)
18 AND 28	FREQ. AND TIME SYSTEMS INC. 4000	
19	ROHDE AND SCHWARZ XSC	
25	HEWLETT-PACKARD 5062C	(ADD 1000 TO THE SERIAL NO.)
90	LABORATORY CESIUM STANDARD NRC	
91	LABORATORY CESIUM STANDARD NBS 4	
92	LABORATORY CESIUM STANDARD PTB CS 1	
99	PROTOTYPE CS	

TABLE 20 - INTERNATIONAL ATOMIC TIME , WEIGHTS OF THE CLOCKS FOR 1981

THE WEIGHTS ARE GIVEN FOR INTERVALS OF TWO MONTHS ENDING AT THE GIVEN DATES

*** DENOTES THAT THE CLOCK WAS NOT USED

LAB.	CLOCK	44659	44719	44779	44839	44899	44969
AOS	19 7	0	5	6	0	3	2
APL	14 121	133	188	200	200	200	159
APL	14 773	193	200	155	76	89	87
APL	14 793	175	200	200	200	200	191
ASMW	16 76	23	26	26	25	21	24
ASMW	16 165	34	38	44	200	200	200
ASUA	16 69	***	0	***	***	0	200
ASUA	16 77	14	20	***	***	0	200
ASUA	17 206	44	28	***	***	0	200
ASUA	17 208	25	36	***	***	0	200
ASUA	99 1	157	200	***	***	0	200
ASUA	99 2	20	23	***	***	0	200
ASUA	99 4	24	***	***	***	0	200
ASUA	99 5	30	22	***	***	0	200
BEV	16 71	0	200	84	***	***	0
F	12 133	0	0	0	0	***	***
F	12 158	***	***	0	66	76	94
F	12 195	200	200	184	200	200	***
F	12 206	47	74	91	122	173	161
F	12 347	20	19	22	27	28	182
F	12 439	0	200	110	55	66	87
F	14 500	***	***	***	***	0	200
F	14 594	***	***	0	200	200	200
F	14 753	***	0	200	200	200	166
F	16 80	119	169	181	***	***	***
F	22 120	166	173	200	200	200	197
F	24 407	0	200	200	179	200	200
F	24 645	115	113	126	85	76	86
F	24 712	***	0	200	200	200	200
FTZ	14 312	***	***	***	0	61	89
FTZ	14 895	***	***	***	0	200	200
FTZ	16 130	***	***	***	0	200	154
FTZ	24 217	***	***	***	0	200	200
FTZ	24 482	***	***	***	0	200	200
FTZ	24 656	***	***	***	0	200	200
IEN	12 303	186	200	187	169	198	162
IEN	12 469	18	24	***	***	0	***
IEN	12 609	193	136	188	175	200	157
IEN	14 893	77	81	200	200	200	187
IEN	16 84	***	0	45	50	72	68

TABLE 20 - (CONT.)

LAB.	CLOCK	44659	44719	44779	44839	44899	44969
IFAG	16 131	200	133	***	***	***	0
IFAG	16 138	149	137	94	66	37	26
IFAG	16 173	6	4	4	***	***	***
NBS	11 137	52	36	***	0	103	184
NBS	11 167	200	200	200	200	180	200
NBS	12 352	0	73	53	30	40	53
NBS	14 316	200	144	153	200	193	200
NBS	14 323	***	0	200	200	200	***
NBS	14 601	***	***	***	0	200	200
NBS	18 8	22	42	62	87	93	197
NBS	22 375	198	200	180	162	179	0
NBS	91 4	***	0	***	***	***	***
NPL	12 316	10	6	0	2	4	5
NPL	12 418	198	200	200	200	200	175
NPL	12 832	76	54	73	100	155	47
NPL	14 334	35	138	175	200	200	***
NRC	12 122	42	14	***	***	***	***
NRC	14 267	200	200	200	198	200	200
NRC	90 5	188	200	200	200	200	200
NRC	90 61	190	200	200	199	200	200
NRC	90 62	200	200	200	200	200	200
NRC	90 63	198	179	200	200	200	200
OAB	16 144	***	***	***	0	156	188
OAB	16 146	0	103	0	***	***	***
OMH	22 67	***	***	***	0	8	17
OMSF	14 896	200	200	200	200	200	200
OMSF	16 113	23	33	43	81	79	111
OMSF	16 121	***	***	***	0	66	32
OMSF	16 177	200	200	171	195	171	173
OMSF	22 223	178	200	188	200	175	172
OMSF	24 569	103	0	***	***	***	***
ON	12 285	57	42	42	79	168	200
ON	12 863	26	19	32	45	62	200
ON	13 14	35	25	20	19	145	200
ON	16 114	91	90	89	***	***	***
ON	24 156	56	69	93	***	***	***
ON	24 796	***	***	***	***	0	77
ORB	12 205	63	76	179	63	28	20
ORB	12 804	34	34	35	54	76	63
PKNM	16 124	13	11	10	39	194	17
PKNM	16 125	20	9	8	13	38	0
PKNM	16 154	7	***	***	***	***	***
PKNM	24 144	123	155	177	192	200	200
PTB	12 320	0	***	***	***	***	***
PTB	12 389	***	0	200	186	144	36

TABLE 20 - (CONT.)

LAB.	CLOCK	44659	44719	44779	44839	44899	44969
PTB	12 462	200	200	200	200	195	37
PTB	14 394	200	200	200	200	200	200
PTB	14 395	200	200	200	200	200	200
PTB	14 867	200	200	200	200	200	200
PTB	16 119	70	63	72	101	112	70
PTB	24 103	200	200	200	179	200	200
PTB	92 1	200	200	199	200	200	200
PTCH	16 64	18	16	13	9	8	16
PTCH	16 140	5	6	6	6	7	0
RGO	11 123	71	51	52	68	134	200
RGO	11 199	60	196	195	200	200	166
RGO	12 348	0	0	4	5	8	14
RGO	14 202	***	***	0	121	159	200
RGO	14 484	14	13	16	***	***	***
RGO	14 560	200	200	200	189	131	150
RGO	14 868	200	200	200	200	200	200
STA	11 200	13	***	***	***	***	***
STA	14 900	150	163	200	200	187	191
STA	16 137	50	36	34	60	105	121
STA	24 376	189	200	200	77	30	***
TP	12 335	27	33	33	29	68	35
TUG	12 524	***	***	***	0	200	200
TUG	24 654	200	200	200	200	200	200
USNO	12 57	***	0	0	5	4	0
USNO	12 58	***	***	0	200	65	***
USNO	12 120	***	***	0	94	34	22
USNO	12 147	57	74	76	100	156	84
USNO	12 150	***	***	0	200	200	200
USNO	12 532	101	81	95	200	200	200
USNO	12 549	0	0	0	1	8	0
USNO	12 573	34	32	31	30	27	24
USNO	12 591	6	6	8	11	***	***
USNO	12 752	145	119	88	113	198	200
USNO	12 761	66	63	71	65	***	***
USNO	12 778	54	185	200	200	200	194
USNO	12 862	200	199	190	***	***	***
USNO	12 873	47	35	41	65	49	63
USNO	14 571	0	84	84	137	158	200
USNO	14 653	51	44	***	***	***	***
USNO	14 783	0	198	190	175	32	40
USNO	14 834	135	125	132	169	186	183
USNO	14 871	0	200	147	96	***	***
USNO	14 875	***	0	***	***	***	***
USNO	16 107	***	***	***	0	51	51
USNO	16 108	***	***	***	***	***	0

TABLE 20 - (CONT.)

LAB.	CLOCK	44659	44719	44779	44839	44899	44969
USNO	16 133	***	***	***	***	***	0
USNO	16 142	***	***	***	***	***	0
USNO	22 114	104	179	175	185	122	53
USNO	22 264	***	0	190	94	156	20
USNO	22 362	***	***	0	***	***	0
USNO	22 585	158	152	200	198	169	***
USNO	22 653	193	200	***	***	***	***
USNO	22 710	38	56	78	199	200	186
USNO	24 25	***	***	0	180	***	***
USNO	24 26	***	0	47	22	15	14
USNO	24 28	0	200	***	***	0	17
USNO	24 33	***	0	87	15	10	11
USNO	24 35	0	200	186	200	200	200
USNO	24 117	102	90	95	140	148	143
USNO	24 300	***	***	***	0	***	***
USNO	24 377	192	180	72	34	27	28
USNO	24 423	192	196	200	200	200	200
USNO	24 449	122	97	81	88	180	***
USNO	24 586	39	41	***	***	***	***
USNO	24 605	80	115	***	***	0	200
USNO	24 688	200	200	200	200	200	144
USNO	24 846	***	***	***	***	***	0
VSL	14 503	200	***	***	0	200	200
VSL	22 34	185	115	73	82	116	193
VSL	22 489	0	29	28	13	***	***
VSL	24 190	81	***	0	90	127	***
ZIPE	12 979	8	0	0	1	1	***

THE CLOCKS ARE DESIGNATED BY THEIR MODEL (2 DIGITS) AND SERIAL NO.
THE CODES FOR THE MODELS ARE

11	HEWLETT-PACKARD 5060A	
12 AND 22	HEWLETT-PACKARD 5061A	(22 001 EQUIVALENT TO 12 1001)
13	EBAUCHES OSCILLATOM. B 5000	
14 AND 24	HEWLETT-PACKARD 5061A OPT.4	(24 001 EQUIVALENT TO 14 1001)
16 AND 26	OSCILLOQUARTZ 3200	(26 001 EQUIVALENT TO 16 1001)
17 AND 27	OSCILLOQUARTZ 3000	(27 001 EQUIVALENT TO 17 1001)
18 AND 28	FREQ. AND TIME SYSTEMS INC. 4000	
19	ROHDE AND SCHWARZ XSC	
25	HEWLETT-PACKARD 5062C	(ADD 1000 TO THE SERIAL NO.)
90	LABORATORY CESIUM STANDARD NRC	
91	LABORATORY CESIUM STANDARD NBS 4	
92	LABORATORY CESIUM STANDARD PTB CS 1	
99	PROTOTYPE CS	

TABLE 21 - MEASUREMENTS OF THE EAL AND TAI FREQUENCY

GRAVITATIONAL FREQUENCY CORRECTIONS ARE APPLIED . THE FREQUENCIES ARE EXPRESSED AT SEA LEVEL .

INTERVAL MJD	CENTRAL DATE	F(EAL)-F(NBS6) IN 10**-13	F(EAL)-F(NRC CSV) IN 10**-13	F(EAL)-F(PTB CS1) IN 10**-13
43909_43989	1979 MAR17		8.24	8.80
43989_44069	1979 JUN 5		7.72	8.24
44064-44116	1979 AUG 5	8.5		
44069_44149	1979 AUG24		7.79	7.64
44149_44229	1979 NOV12		7.05(1)	8.07
44229_44309	1980 JAN31		8.84	9.31
44249_44329	1980 FEB20	8.60		
44309_44389	1980 APR20		9.57	8.99
44389_44469	1980 JUL 9		8.98	8.45
44469_44549	1980 SEP27		8.35(1)	8.04
44549-44629	1980 DEC16		8.52	8.67
44629-44709	1981 MAR 6		9.16	9.12
44709-44789	1981 MAY25		8.63	8.42
44789-44869	1981 AUG13		7.92	7.86
44889-44969	1981 NOV21		7.99(1)	7.98

INTERVAL MJD	CENTRAL DATE	F(TAI)-F(NBS6) IN 10**-13	F(TAI)-F(NRC CSV) IN 10**-13	F(TAI)-F(PTB CS1) IN 10**-13
43909_43989	1979 MAR17		-0.76	-0.20
43989_44069	1979 JUN 5		-1.23	-0.71
44064-44116	1979 AUG 5	-0.3		
44069_44149	1979 AUG24		-0.91	-1.06
44149_44229	1979 NOV12		-1.40(1)	-0.38
44229_44309	1980 JAN31		0.44	0.91
44249_44329	1980 FEB20	0.20		
44309_44389	1980 APR20		1.17	0.59
44389_44469	1980 JUL 9		0.58	0.05
44469_44549	1980 SEP27		-0.05(1)	-0.36
44549-44629	1980 DEC16		0.12	0.27
44629-44709	1981 MAR 6		0.76	0.72
44709-44789	1981 MAY25		0.23	0.02
44789-44869	1981 AUG13		-0.48	-0.54
44889-44969	1981 NOV21		-0.41(1)	-0.42

(1) COMPUTED JUST AFTER A FULL EVALUATION OF NRC-CSV

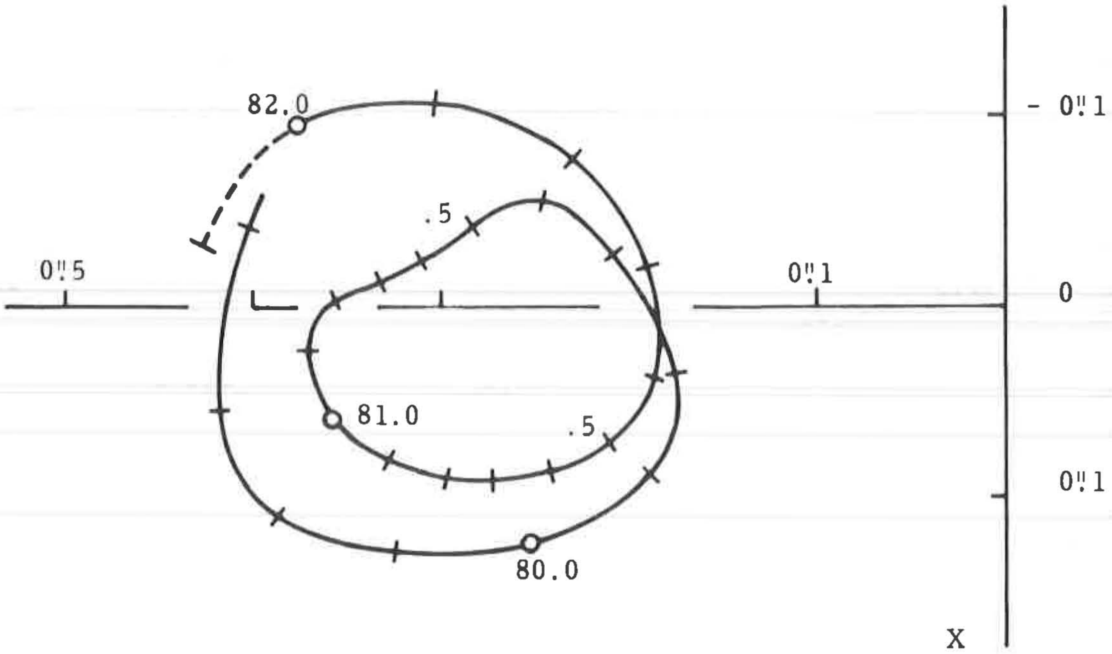

Fig 1. Path of the pole from 1979.6 to 1982.0. Smoothed values of Table 6C, obtained by the Vondrak's method, with the coefficient of smoothing which equalizes the internal and external standard deviations in x and y.

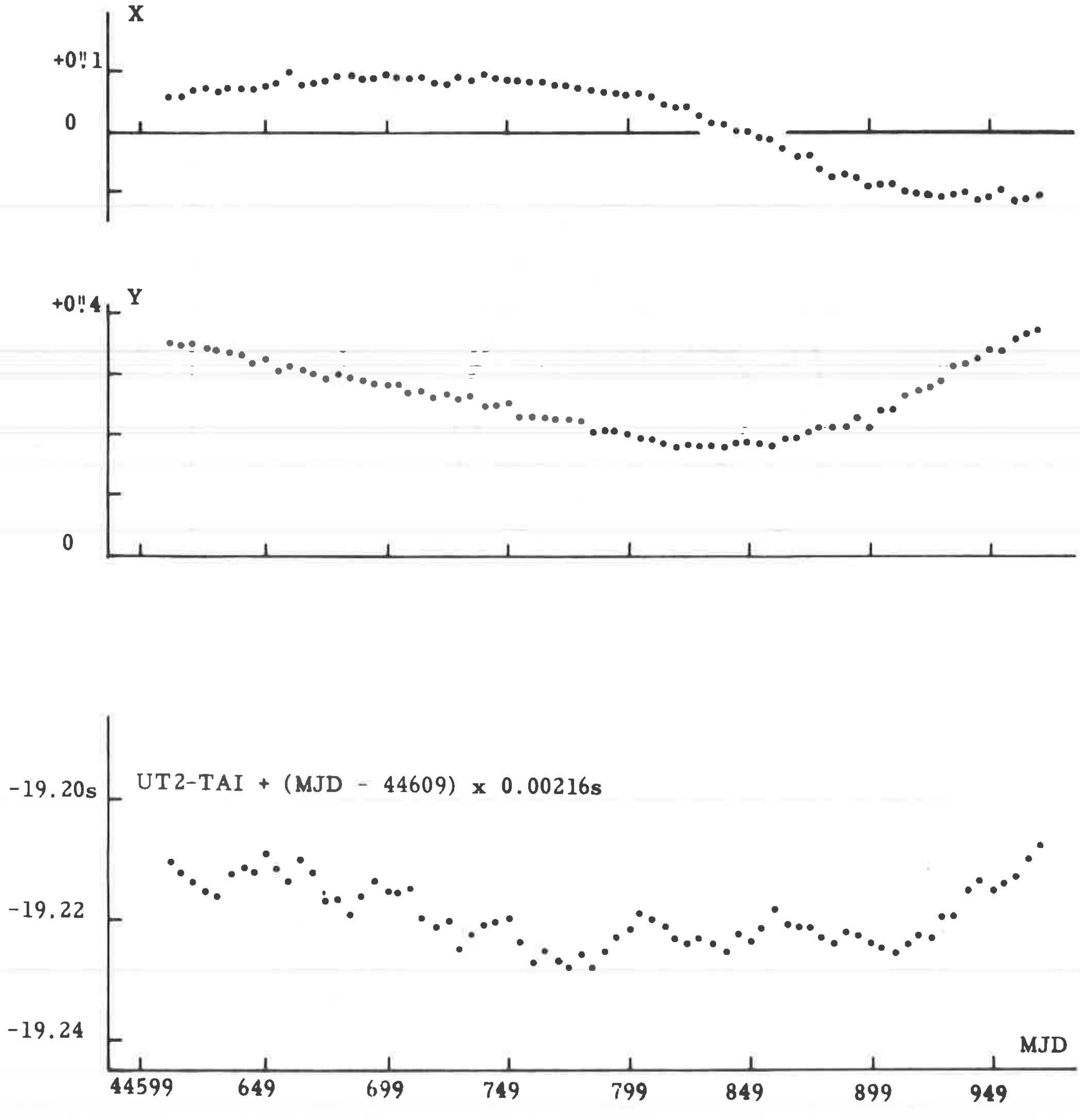

Fig. 2. Raw Values of x, y, UT2-TAI (Table 6 for 1981), 5-day means.

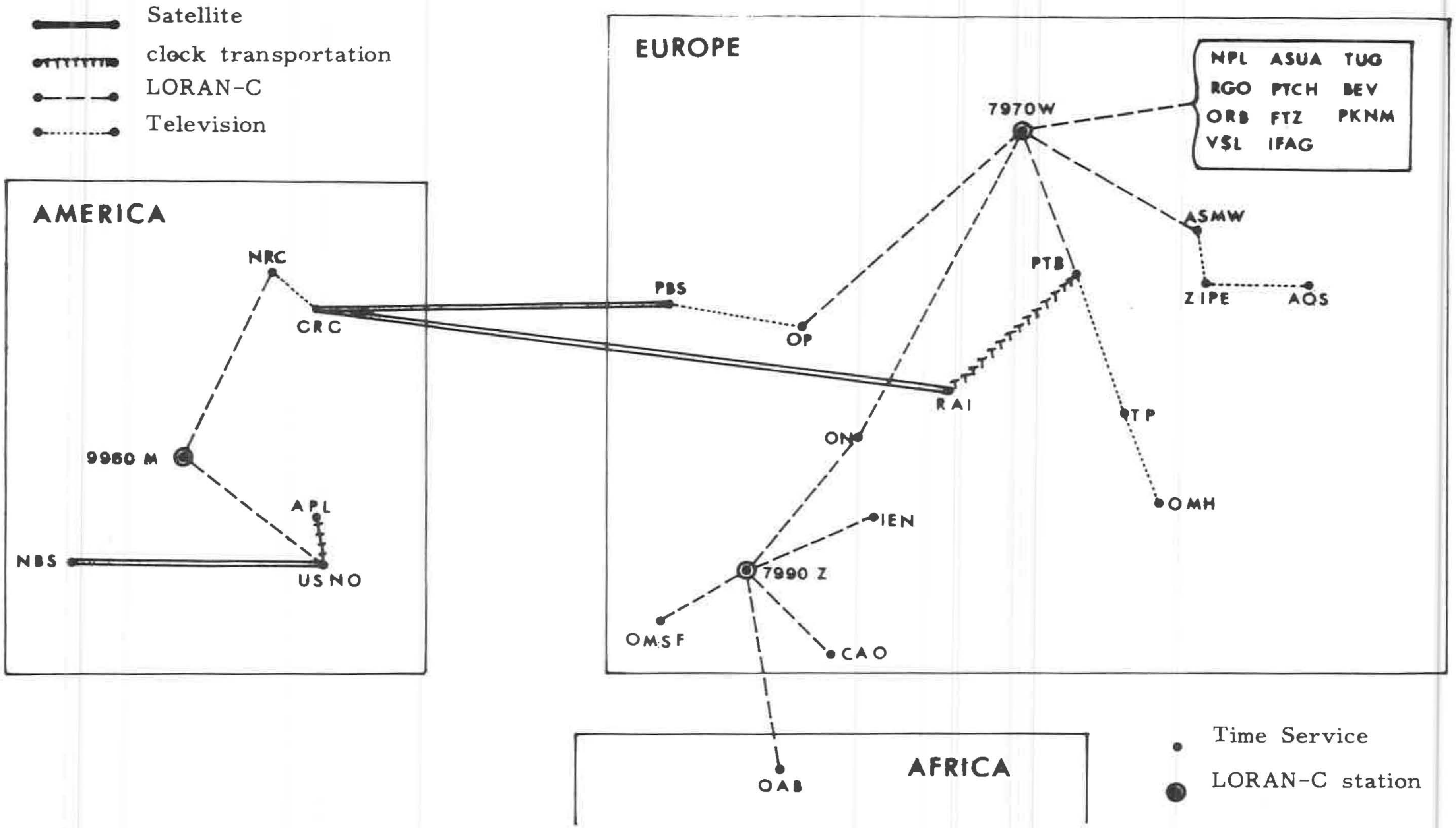

Fig. 3. Time links used by the BIH for establishing TAI end 1981*. The two links between CRC and 7970W are averaged.

* Early 1981 (MJD = 44609 to MJD = 44769), the reception by NBS of the LORAN-C chain 9960Z was used.

PART C

TIME SIGNALS (1982)

The time signal emissions reported thereafter follow the UTC system, in accordance with the Recommandation 460-2 of the International Radio Consultative Committee (CCIR), unless otherwise stated.

Their maximum departure from the Universal Time UT1 is thus 0.9 second.

AUTHORITIES RESPONSIBLE FOR THE TIME SIGNAL EMISSIONS

Signal	Authority
ATA	National Physical Laboratory Hillside Road New Dehli – 110012, India
BPM	Shaanxi Astronomical Observatory Academia Sinica P. O. Box 18 – Lintong near Xian China
BSF	Telecommunication Laboratories Directorate General of Telecommunications Ministry of Communications P. O. Box 71 – Ching-Li 320 Taiwan, China
CHU	National Research Council, Time and Frequency Section Physics Division (M-36) Ottawa K1A OS1, Ontario, Canada Attn : Dr. C. C. Costain
DAM, DAN, DAO	Deutsches Hydrographisches Institut Postfach 220 2000 Hamburg 4, Federal Republic of Germany
DCF77	Physikalisch-Technische Bundesanstalt, Laboratorium 1-21 Federal Republic of Germany Bundesallee 100 D33 Braunschweig
DGI, Y3S	Amt für Standardisierung: Messwesen und Warenprüfung Fachabteilung Elektrizität und Magnetismus Fachgebiet Zeit und Frequenz Fürstenwalder Damm 388 DDR 1162 Berlin
EBC	Instituto y Observatorio de Marina San Fernando Cadiz, Spain
FFH	Centre National d'Études des Télécommunications Division : Dispositif de Traitement du Signal Département : Étalons de fréquence et de temps 196, rue de Paris 92220 Bagneux, France

Signal	Authority
FTH42, FTK77, FTN87	Laboratoire Primaire du Temps et des Fréquences Observatoire de Paris 61, avenue de l'Observatoire 75014 Paris, France
GBR	1/ Time information : Royal Greenwich Observatory Herstmonceux Castle Hailsham, East Sussex BN27 1 RP, United Kingdom 2/ Standard Frequency information : National Physical Laboratory Electrical Science Division Teddington, Middlesex TW11 OLW, United Kingdom
HBG	Service horaire HBG Observatoire Cantonal CH – 2000 Neuchâtel, Suisse
IAM	Istituto Superiore delle Poste e delle Telecomunicazioni Ufficio 8°, Rep. 3° - Viale Europa 00100 – Roma, Italy
IBF	Istituto Elettrotecnico Nazionale Galileo Ferraris Strada delle Cacce, 91 10135 – Torino, Italy
JJY, JG2AS	Frequency Standard Division The Radio Research Laboratories Ministry of Posts and Telecommunications Koganei, Tokyo 184, Japan
LOL	Director Observatorio Naval Av. España 2099 1107 – Buenos-Aires, Republica Argentina
LQB9, LQC20	Instituto Geografico Militar (IGMA) Servicio internacional de la Hora Seccion Conservacion de la Hora Calle 38 Gral Savio 865 1650 Villa Maipu, San Martin Pcia de Buenos-Aires Republica Argentina
MSF	National Physical Laboratory Electrical Science Division Teddington, Middlesex TW11 OLW United Kingdom

Signal	Authority
OLB5, OMA	1/ Time information : Astronomický Ústav ČSAV, Budečská 6, 120 23 Praha 2, Vinohrady, Czechoslovakia. TELEX : 122 486 2/ Standard frequency information : Ústav radiotechniky a elektroniky ČSAV, Lumumbova 1, 182 51 Praha 8, Kobylisy, Czechoslovakia. TELEX : 122 646
PPE, PPR	Serviço da Hora Observatório Nacional (CNPq) Rua General Bruce, 586 20921 Rio de Janeiro – RJ, Brasil
RBU, RCH RID, RTA, RTZ, RWM UQC3, UTR3	Comité d'État des Normes Conseil des Ministre de l'URSS Moscou 117049, URSS, Leninski prosp., 9
VNG	Time and Frequency Standards Section Telecom Australia Research Laboratories Box 249 Clayton, Victoria 3168, Australia
WWV, WWVH WWVB	Time and Frequency Services Group Time and Frequency Division National Bureau of Standards Boulder, Colorado 80303, U. S. A.
YVTO	Direccion de Hidrografia y Navegacion Observatori Cagigal Apartado Postal N°6745 Caracas, Venezuela
Y3S	See DGI
ZUO	National Physical Research Laboratory P. O. Box 395 Pretoria South Africa

TIME - SIGNALS EMITTED IN THE UTC SYSTEM

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of time signals
ATA	Greater Kailash Delhi India 28° 34'N 77° 19'E	5 000 10 000 15 000	3h 30 m to 14h 30 m on Monday to Saturday no transmission on Sundays and Govt Holidays, continuous operation projected.	Second pulses of 5 cycles of a 1 kHz modulation. Minute pulses of 100 ms duration.
BPM	Xian China 35° 0'N 139° 31'E	5 000 10 000 15 000	from 14h to 24h continuous from 0h to 14h	UTC time signals (the signals are emitted in advance on UTC by 10ms). Second pulses of 5 ms of 1 kHz modulation. Minute pulses of 300ms of 1 kHz modulation. From minutes 0 to 5, 15 to 25, 30 to 35, 45 to 55. UT1 time signals are emitted from minutes 5 to 10, 25 to 29, 35 to 40, 55 to 59.
BSF	Chung-Li Taiwan China 24° 57'N 121° 9'E	5 000 15 000	continuous except interruption between minutes 35 and 40	(a) From min. 5 to 10, 15 to 20, 25 to 30, 45 to 50, 55 to 60, second pulses of 5ms duration without 1 kHz modulation. (b) From min. 0 to 5, 10 to 15, ..., 50 to 55, second pulses of 5ms duration with 1 kHz modulation. The 1 kHz modulation is interrupted 40ms before and after the pulses. (c) Minute pulses are extended to 300ms. (d) DUT1, CCIR code by lengthening.
CHU	Ottawa Canada 45° 18'N 75° 45'W	3 300 7 335 14 670	continuous	Second pulses of 300 cycles of a 1 kHz modulation. Minute pulses are 0.5s long. A bilingual (Fr. Eng.) announcement of time is made each minute FSK time code on 31st to 39th seconds. Broadcast is single sideband ; upper sideband with carrier reinserted. DUT1 : CCIR code by split pulses.
DAM	Elmshorn Germany, F.R. 53° 46'N 9° 40'E	8 638.5 16 980.4 4 265 8 638.5 6 475.5 12 763.5	11h 55 m to 12h 06m 23h 55m to 24h 06m from 21 Oct. to 26 March 23h 55m to 24h 06m from 27 March to 20 Oct.	New international system, then second pulses from minutes 0.5 to 6.0 (minute pulses prolonged). A1 Type DUT1 : CCIR code by doubling, after minute pulses 1 to 5
DAN	Osterloog Germany, F.R. 53° 38'N 7° 12'E	2 614	11h 55m to 12h 06m 23h 55m to 24h 06m	As DAM (see above)
DAO	Kiel Germany, F.R. 54° 26'N 10° 8'E	2 775	11h 55m to 12h 06m 23h 55m to 24h 06m	As DAM (see above)
DCF77	Mainflingen Germany, F.R. 50° 1'N 9° 0'E	77.5	continuous	At the beginning of each second (except the 59th second) the carrier amplitude is reduced to about 25% for a duration of 0.1s or 0.2s respectively. Coded transmission of year, month, day, hour, minute and day of the week in a BCD code from second marker N° 20 to N° 58 (the second marker durations of 0.1s or 0.2s correspond to a binary 0 or a binary 1 respectively). Zonal time code by the second markers N° 16 to 18. Second marker N° 15 with a duration of 0.2s indicates that the reserve antenna is in use. No transmission of DUT1.

Notes : see p. C-10

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of time signals
DGI	Oranienburg Germ. Dem. Rep. 52° 48'N 13° 24'E	182	5h 59m 30s to 6h 00m 11h 59m 30s to 12h 00m 17h 59m 30s to 18h 00m	A2 type second pulses of 0.1s duration for seconds 30-40, 45-50, 55-60. The last pulse is prolonged. (one hour earlier in summer time)
EBC (2)	San Fernando Spain 36° 28'N 6° 12'W	12 008 12 008 6 840 6 840	10h 00m to 10h 10m (A_2) 10h 15m to 10h 25m (A_3J) 10h 30m to10h 40m (A_2) 10h 45m to 10h 55m (A_3J)	Second pulses of 0.1s duration of a 1 kHz modulation. Minute pulses of 0.5s duration of 1 250 Hz modulation DUT1, CCIR code, double pulse. (A_2) amplitude modulation. (A_3J) single sideband, cancelled carrier.
FFH	Ste Assise France 48° 33'N 2° 34'E	2 500	continuous from 8h to 16h 25m except on Sunday	Second pulses of 5 cycles of 1 kHz modulation. Minute pulses prolonged to 0.5s. DUT1 : CCIR code by lenghtening to 0.1s.
FTH42 FTK77 FTN87	Ste Assise France 48° 33'N 2° 34'E	7 428 10 775 13 873	at 9h and 21h at 8h and 20h at9h 30m, 13h, 22h 30m,	A1 type second pulses during the 5 minutes preceding the indicated times. Minute pulses are prolonged. DUT1 : in morse code.
GBR (3)	Rugby United Kingdom 52° 22'N 1° 11'W	16	2h 55m to 3h 00m 8h 55m to 9h 00m 14h 55m to 15h 00m 20h 55m to 21h 00m	A1 type second pulses lasting 100ms, lengthened to 500 ms at the minute. The reference point is the start of carrier rise. Uninterrupted carrier is transmitted for 24s from 54m 30s and from 0m 6s. DUT1 : CCIR code by double pulses.
HBG	Prangins Switzerland 46° 24'N 6° 15'E	75	continuous	Interruption of the carrier at the beginning of each second, during 100ms. The minutes are identified by a double pulse, the hours by a triple pulse. No transmission of DUT1.
IAM	Rome Italy 41° 47'N 12° 27'E	5 000	7h 30m to 8h 30m 10h 30m to 11h 30m except Sat. afternoon, Sund., and national holidays. Advanced by 1h in summer.	Second pulses of 5 cycles of 1 kHz modulation. Minute pulses of 20 cycles (Announcements 5m before the emission of time signals).
IBF	Torino Italy 45° 2'N 7° 42'E	5 000	During 15m preceding 7h, 9h, 10h, 11h, 12h, 13h, 14h, 15h, 16h, 17h, 18h. Advanced by 1 hour in summer.	Second pulses of 5 cycles of 1 kHz modulation. These pulses are repeated 7 times at the minute. Voice announcements at the beginning and end of each emission. Time announcement (C.E.T.) by Morse code every ten minutes beginning at 0h 0m. DUT1 : CCIR code by double pulse.
JG2AS	Sanwa Ibaraki Japan 36° 11'N 139° 51'E	40	continuous, except interruptions during communications.	A1 type second pulses of 0.5s duration. Second 59 is of 0.1s. No DUT1 code.
JJY	Sanwa Ibaraki Japan 36° 11'N 139° 51'E	2 500 5 000 8 000 10 000 15 000	continuous, except interruption between minutes 35 and 39.	Second pulses of 8 cycles of 1 600 Hz modulation. Minute pulses are preceded by a 600 Hz modulation. DUT1 : CCIR code by lengthening.

Notes : see p. C-10

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of time signals
LOL1 (1)	Buenos-Aires Argentina 34° 37'S 58° 21'W	5 000 10 000 15 000	11h to 12h, 14h to 15h, 17h to 18h, 20h to 21h, 23h to 24h	Second pulses of 5 cycles of 1 000 Hz modulation. Second 59 is omitted. Announcement of hours and minutes every 5 minutes, followed by 3m of 1 000 Hz or 440 Hz modulation. DUT1 : CCIR code by lengthening.
LOL2 LOL3 (1)	Buenos-Aires Argentina 34° 37'S 58° 21'W	4 856 8030 17 180	1h 13h, 21h,	A1 second pulses during the 5 minutes preceding the indicated times. Second 29 is omitted. Minute pulses are prolonged. DUT1 : CCIR code by double pulse.
LQB9 LQC20	Planta Gral Pacheco 34° 26'S 58° 37'W	8 167.5 17 551.5	22h 5m, 23h 50m 10h 5m, 11h 50m	A1 second pulses during the 5 minutes preceding the indicated times. Second 59 is omitted, second 60 is prolonged. After the emission, OK is transmitted if the emission is correct, NV if not correct. DUT1 : CCIR code by double pulse.
MSF	Rugby United Kingdom 52° 22'N 1° 11'W	60	continuous except for an interruption for maintenance from 10h 0m to 14h 0m on the first Tuesday in each month.	Interruptions of the carrier of 100ms for the second pulses, of 500ms for the minute pulses. The signal is given by the beginning of the interruption. BCD NRZ code, 100 bits/s (month, day of month, hour, minute), during minute interruptions. BCD PWM code, 1 bit/s (year, month, day of month, day of week, hour, minute) from seconds 17 to 59 in each minute. DUT1 : CCIR code by double pulse.
MSF	Rugby United Kingdom 52° 22'N 1° 11'W	2 500 5 000 10 000	between minutes 0 and 5, 10 and 15, 20 and 25, 30 and 35, 40 and 45, 50 and 55.	Second pulses of 5 cycles of 1 kHz modulation. Minute pulses are prolonged. DUT1 : CCIR code by double pulse.
OLB5	Poděbrady Czechoslovakia 50° 9'N 15° 9'E	3 170	continuous except from 6h to 12h on the first Wednesday of every month	A1 type, second pulses. No transmission of DUT1.
OMA (4)	Liblice Czechoslovakia 50° 4'N 14° 53'E	50	continuous (from 6h to 12h on the first Wednesday in each month, emitted from Poděbrady with reduced power)	Interruption of the carrier of 100ms at the beginning of every second, of 500ms at the beginning of every minute. The precise time is given by the beginning of the interruption. Phase coded announcement of date, UT and local civil time. No DUT1 code.
OMA	Liblice Czechoslovakia 50° 4'N 14° 53'E	2 500	between minutes 1 and 15 16 and 30, 31 and 45, 46 and 60 of every hour except from 6h to 12h on the first Wednesday of every month.	Pulses of 5 cycles of 1 kHz modulation (prolonged for the minutes). No transmission of DUT1.
PPE	Rio-de-Janeiro Brasil 22° 54'S 43° 13'W	8 721	0h 30m, 11h 30m, 13h 30m, 19h 30m, 20h 30m, 23h 30m	Second ticks, of A1 type, during the five minutes preceding the indicated hours. The minute ticks are longer. DUT1 : CCIR code by double pulse.

Notes : see p. C-10

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of the time signals
PPR	Rio-de-Janeiro Brasil 22° 59' S 43° 11' W	435 4 244 8 634 13 105 17 194.4 22 603	1h 30m, 14h 30m, 21h 30m	Second ticks, of A1 type, during the five minutes preceding the indicated hours. The minute ticks are longer.
RBU (5)	Moscow USSR 55° 48' N 38° 18' E	66 2/3	continuous	A1X type second pulses. The pulses at beginning of the minute are prolonged to 0.5 s.
RCH (5)	Tashkent USSR 41° 19' N 69° 15' E		between minutes 0 and 10, 30 and 40	Second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s.
		2 500	0h to 3h 40m 5h 30m to 23h 40m	
		5 000	0h to 1h 10m 2h to 3h 40m 14h to 17h 10m 18h to 23h 40m	
		10 000	5h 30m to 9h 10m 10h to13h 10m	
RID (5)	Irkutsk USSR 52° 26' N 104° 2' E	5 004 10 004 15 004	The station simultaneously operates on three frequencies between minutes 20 and 30 50 and 60.	Second pulses. The pulses at the beginning of the minute are prolonged to 0.5 s.
RTA (5)	Novossibirsk USSR 55° 4' N 82° 58' E		between minutes 0 and 10, 30 and 40	Second pulses. The pulses at the beginning of the minute are prolonged.
		10 000	0h to 1h 10m 2h to 4h 40m 14h to 17h 10m 18h to 23h 40m	
		15 000	6h 30m to 9h 10m 10h to 13h 10m	
RWM (5)	Moscow USSR 55° 48' N 38° 18' E	4 996 9 996 14 996	The station simultaneously operates on three frequencies between minutes 10 and 20, 40 and 50	Second pulses. The pulses at the beginning of the minute are prolonged to 0.5s.
RTZ (5)	Irkutsk USSR 52° 26' N 104° 2' E	50	between minutes 0 and 5, from 1h to 23h 5m Advanced by 1 hour in summer	A1 type second pulses. The pulses at the beginning of the minute are prolonged to 0.5s.
UQC3	Chabarovsk USSR 48° 30' N 134° 51' E	25	from 0h 43m to 0h 52m, from 6h 43m to 6h 52m from 17h 43m to 17h 52m in winter (1 Oct. to 31 March) from 2h 43m to 2h 52m from 6h 43m to 6h 52m from 18h 43m to 18h 52m in summer (1 April to 30 Sept.)	A1X type 0.1 second pulses of 0.025s duration. Second pulses are prolonged to 0.1s ; 10 second pulses are prolonged to 1s and minute pulses are prolonged to 10s. No transmission of DUT1 code.

Notes : see p. C-10

Station	Location Latitude Longitude	Frequency (kHz)	Schedule (UT)	Form of the time signals
UTR3	Gorki USSR 56° 11' N 43° 58' E	25	from 5h 43m to 5h 52m from 13h 43m to 13h 52m from 18h 43m to 18h 52m in winter (1 Oct. to 31 March) from 7h 43m to 7h 52m from 14h 43m to 14h 52m from 19h 43m to 19h 52m in summer (1 April to 30 Sept.)	A1X type 0.1 second pulses of 0.025s duration. Second pulses are prolonged to 0.1s ; 10 second pulses are prolonged to 1s and minute pulses are prolonged to 10s. No transmission of DUT1 code.
VNG	Lyndhurst Australia 38° 3' S 145° 16' E	4 500 7 500 12 000	9h 45m to 21h 30m continuous except 22h 30m to 22h 45m 21h 45m to 9h 30m	Second markers of 50 cycles of 1 kHz modulation; 5 cycles only for second markers 55 to 58 ; second marker 59 is omitted ; 500 cycles for minute markers. During the 5th, 10th, 15th, etc... minutes, 5 cycles for second markers 50 to 58. Identification by voice announcement during 15th, 30th, 45th and 60th minutes. DUT1 : CCIR code by 45 cycles of 900 Hz modulation immediately following the normal second markers.
WWV	Fort-Collins USA 40° 41' N 105° 2' W	2 500 5 000 10 000 15 000 20 000	continuous	Pulses of 5 cycles of 1 kHz modulation. 59th and 29th second pulses omitted. Hour is identified by 0.8 second long 1 500 Hz tone. Beginning of each minute identified by 0.8 second long 1 000 Hz tone. DUT1 : CCIR code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.
WWVB	Fort-Collins USA 40° 40' N 105° 3' W	60	continuous	Second pulses given by reduction of the amplitude of the carrier. Coded announcement of the date and time and of the correction to obtain UT1. No CCIR code.
WWVH	Kauai- USA 21° 59' N 159° 46' W	2 500 5 000 10 000 15 000	continuous	Pulses of 6 cycles of 1 200 Hz modulation. 59th and 29th second pulses omitted. Hour identified by 0.8 second long 1 500 Hz tone. Beginning of each minute identified by 0.8 second long 1 200 Hz tone. DUT1 : CCIR code by double pulse. BCD time code given on 100 Hz subcarrier, includes DUT1 correction.
YVTO	Caracas Venezuela 10° 30' N 66° 56' W	6 100	continuous	Second pulses of 1 kHz modulation with 0.1s duration. The minute is identified by a 800 Hz tone and a 0.5s duration. Second 30 is omitted. Between seconds 40 and 50 of each minute, voice announcement of the identification of the station. Between seconds 52 and 57 of each minute, voice announcement of hour, minute and second.
Y3S (6)	Nauen Germ. Dem. Rep. 52° 39' N 12° 55' E	4 525	continuous except from 8h 15m to 9h 45m for maintenance if necessary	A1 type second pulses of 0.1s duration. Minute pulses prolonged to 0.5s. DUT1 : CCIR code by double pulse.
ZUO	Olifantsfontein South Africa 25° 58' S 28° 14' E	2 500 5 000	18h to 4h continuous	Pulses of 5 cycles of 1 kHz modulation. Second 0 is prolonged. DUT1 : CCIR code by lengthening.
ZUO	Johannesburg South Africa 26° 11' S 28° 4' E	100 000	continuous	Pulses of 5 cycles of 1 kHz modulation. Second 0 is prolonged. DUT1 : CCIR code by lengthening.

Notes : see p. C-10

Notes on the characteristics of time signals

(1) No recent information on these time signals.

(2) EBC

Planned change during the second half of 1982 :

12 008 kHz	from 10h 0m to 10h 25m	type A3H
6 840 kHz	from 10h 30m to 10h 55m	

(3) The modulation system used by GBR outside the time-signals is likely to change to a form of minimum-shift keying sometime after the end of 1983. Some standard-frequency and phase-tracking receivers may not work without modification. Details of the new system are not yet available. No changes are planned in the form of the time-signals.

(4) OMA, 50 kHz

a. The main transmitter in Liblice radiates approx. 7 kW and the stand-by transmitter in Poděbrady approx. 50 W.

b. The details of the time code were published in Nomenclature des stations de radiorepérage et des stations effectuant des services spéciaux - Liste VI, Volume I, édition 7 de U.I.T. in Geneva in July 1980.

(5) The radiostations of the USSR emit UT1 information in accordance with the CCIR code. Furthermore they give an additional information dUT1 specifying more precisely the difference UT1 - UTC down to multiples of 0.02s, the total value of the correction being DUT1 + dUT1. Positive values of dUT1 are transmitted by the marking of p second markers within the range between the 21 th and 24 th second so that dUT1 = +0.02 s x p. Negative values of dUT1 are transmitted by the marking of q second markers within the range between the 31 th and the 34 th second, so that dUT1 = -0.02s x p.

(6) Y3S

DUT1 information in CCIR code.
dUT1 information. This additional information specifies more precisely the difference UT1 - UTC down to multiples of 0.02s, the total value of the correction being DUT1 + dUT1.

A positive value of dUT1 is indicated by doubling a number (p) of consecutive seconds markers from seconds marker 21 to seconds marker (20 + p) inclusive ; (p) being an integer from 1 to 5 inclusive.

$$dUT1 = p.\,0.02s.$$

A negative value of dUT1 is indicated by doubling a number (q) of consecutive seconds markers following the minute marker from seconds marker 31 to seconds marker (30 + q) inclusive ; (q) being an integer from 1 to 5 inclusive.

$$dUT1 = -(q.\,0.02)s.$$

The seconds marker 28 following the minute marker is doubled as parity bit, if the value of (p) or (q) is an even number or if dUT1 = 0.

Time-information. During the last 20 seconds of each minute in a BCD-Code an information about the value "minute" and "hour" in the UTC time scale of the following minute marker is given.

UNCERTAINTY OF THE CARRIER FREQUENCY

The carriers of the following time signals are standard frequencies.

Station	Relative uncertainty of the carrier frequency in 10^{-10}
ATA	0.1
BSF	0.2
CHU	0.05
DCF77	0.005
FFH	0.2
GBR	0.02
HBG	0.005
IAM	0.5
IBF	0.1
JJY, JG2 AS	0.1
LOL1	0.1
MSF (60 kHz)	0.02
MSF (h. f.)	0.02
OMA (all frequencies)	0.5
RBU, RTZ	0.05
RCH, RID, RTA, RWM	0.5
UQC3, UTR3	0.1 - 0.2
VNG	0.1
WWV	0.1
WWVB	0.1
WWVH	0.1
ZUO	0.1

TIME OF EMISSION OF THE TIME SIGNALS IN THE UTC SYSTEM, IN 1981

The following deviations of the time of emission of time signals, from UTC, have been reported to the BIH, or observed.

BPM	UTC - BPM = -0.0100
OLB5	UTC - OLB5 = 0.0008s