



INTERNATIONAL ATOMIC ENERGY AGENCY
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION
INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS
ICTP, P.O. BOX 586, 34100 TRIESTE, ITALY, CABLE: CENTRATOM TRIESTE



H4.SMR/453-34

**TRAINING COLLEGE ON
PHYSICS AND CHARACTERIZATION
OF LASERS AND OPTICAL FIBRES**

(5 February - 2 March 1990)

**OPTICAL FIBRE
COMMUNICATIONS**

F. Tosco

**CSELT
Torino, Italy**

OPTICAL FIBRE COMMUNICATIONS

F. TOSCO

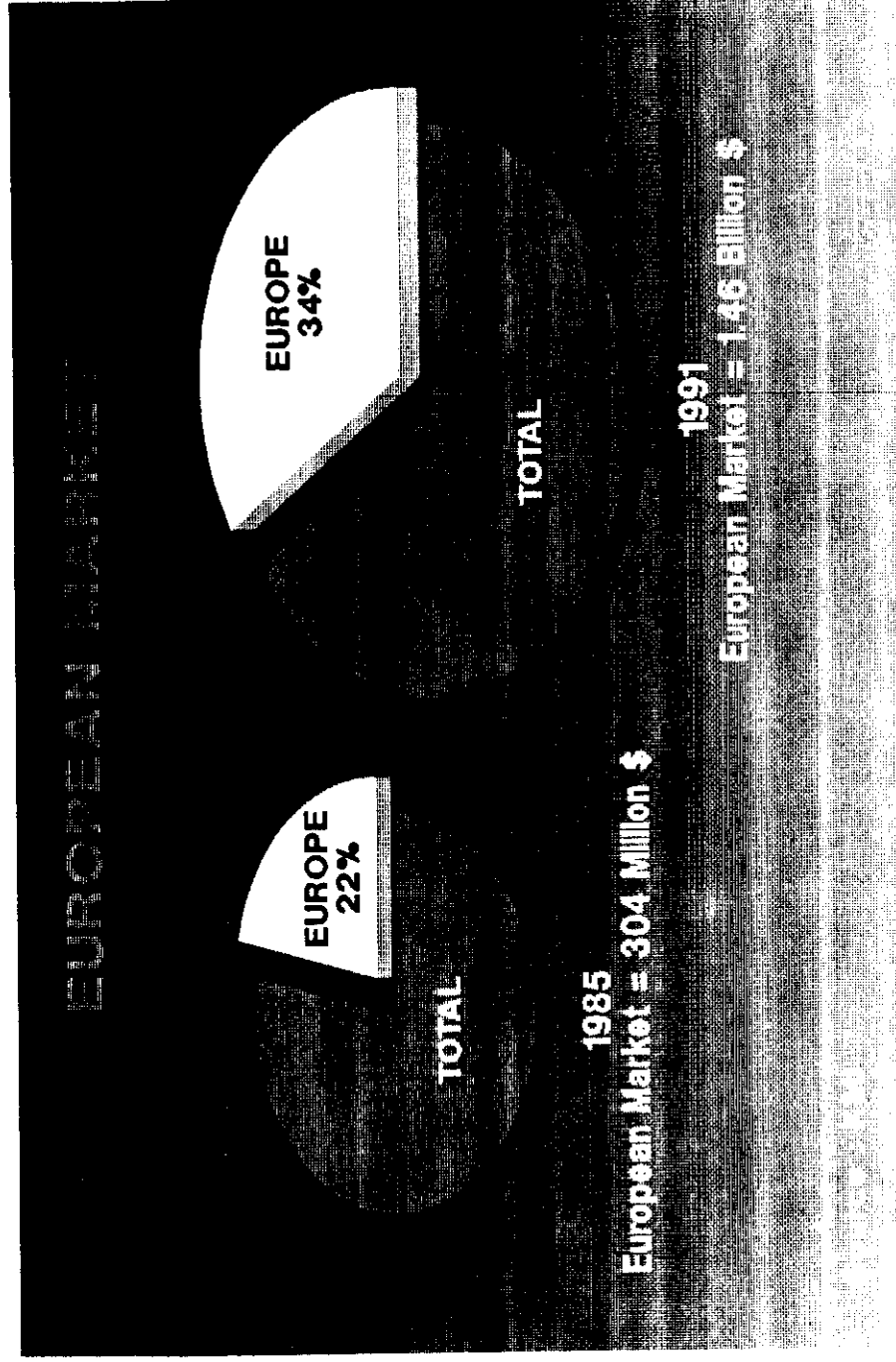
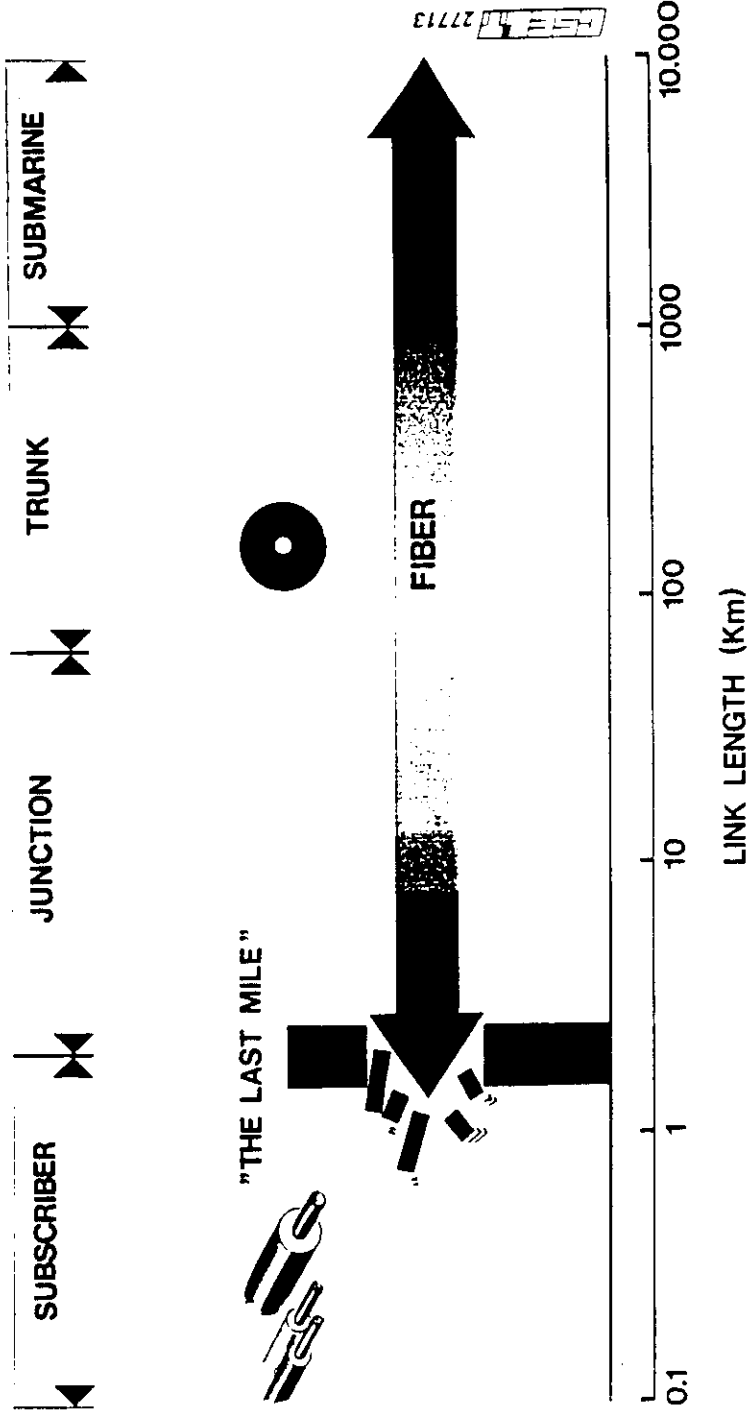
STET - Centro Studi e Laboratori
Telecomunicazioni S.p.A. - Torino (Italy)

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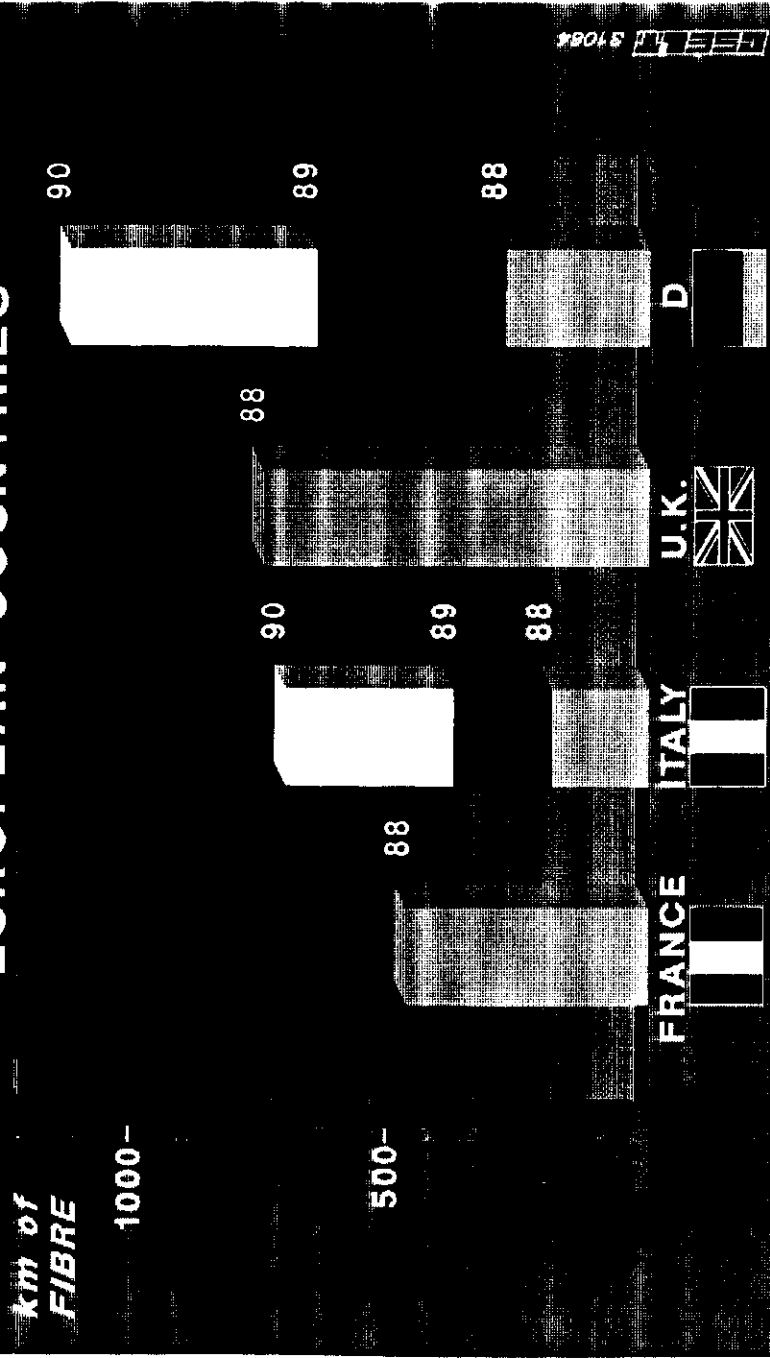
SUMMARY

- HISTORICAL REMARKS
- MARKET SURVEY
- COSTS ANALYSES
 - LONG DISTANCE
 - DISTRIBUTION NETWORK
- PERSPECTIVES

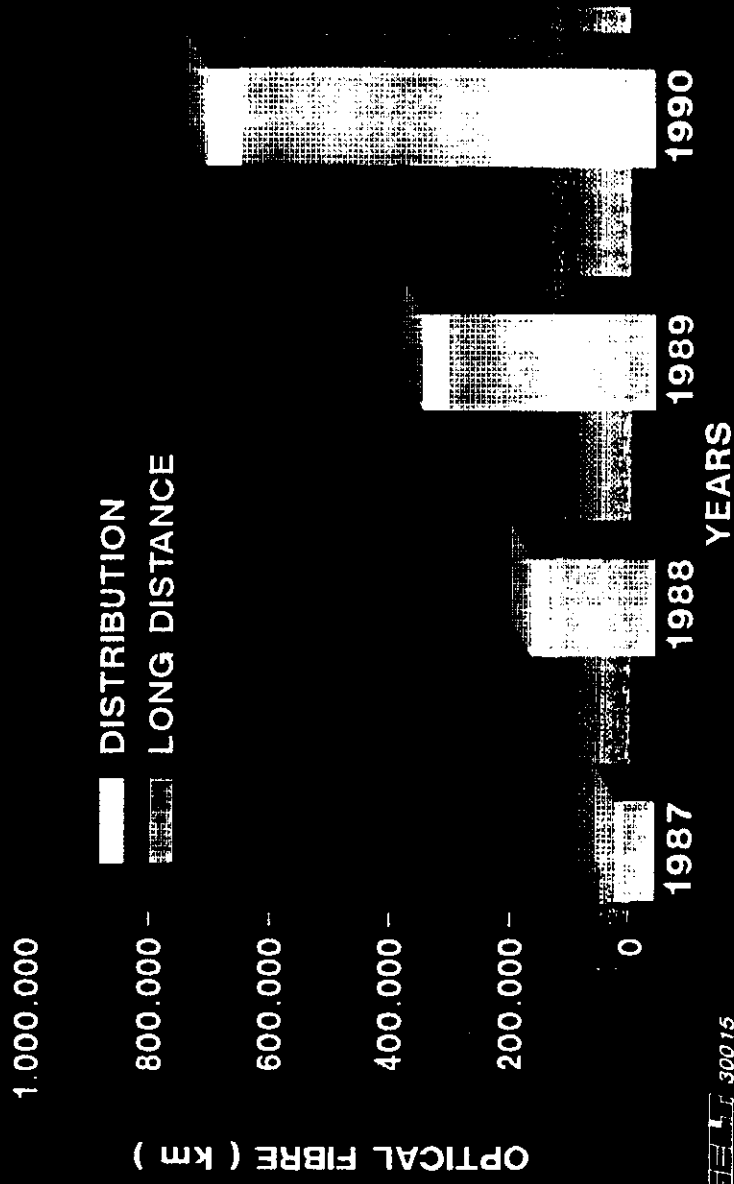
OPTICAL FIBRES IN THE PUBLIC TELECOMMUNICATION NETWORK



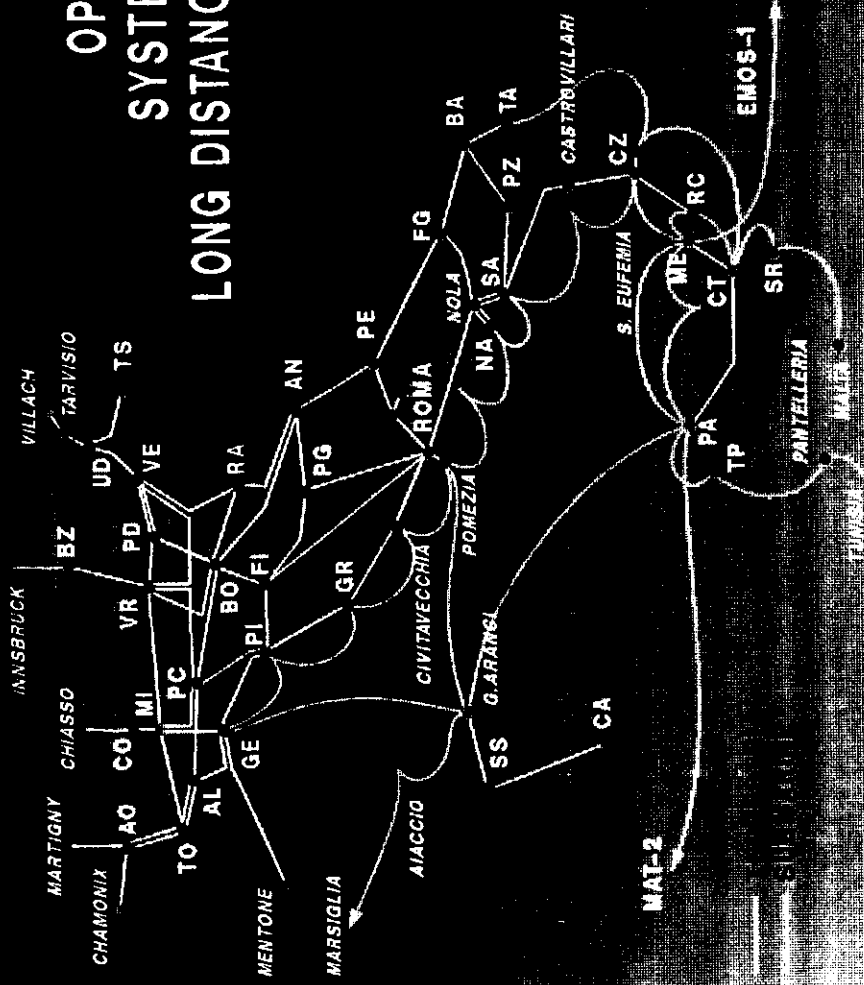
OPTICAL FIBRE IN THE MAIN EUROPEAN COUNTRIES



INSTALLED OPTICAL FIBRES IN ITALY



OPTICAL FIBRE SYSTEMS IN ITALY LONG DISTANCE NETWORK



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FIBRE OPTIC MARKET BY APPLICATION SEGMENT (U.S.A. Market)



Source: KESSLER MARKETING INTERNATIONAL

THE FLOWERING OF FIBER

Optical Fiber In Distribution
And Subscriber Loops
In The United States

Optical Fiber In Feeder,
Distribution And Subscriber
Loops In Europe

33,000 km 

59,000 km 

324,000 km 

371,000 km 

1988

1989

1988

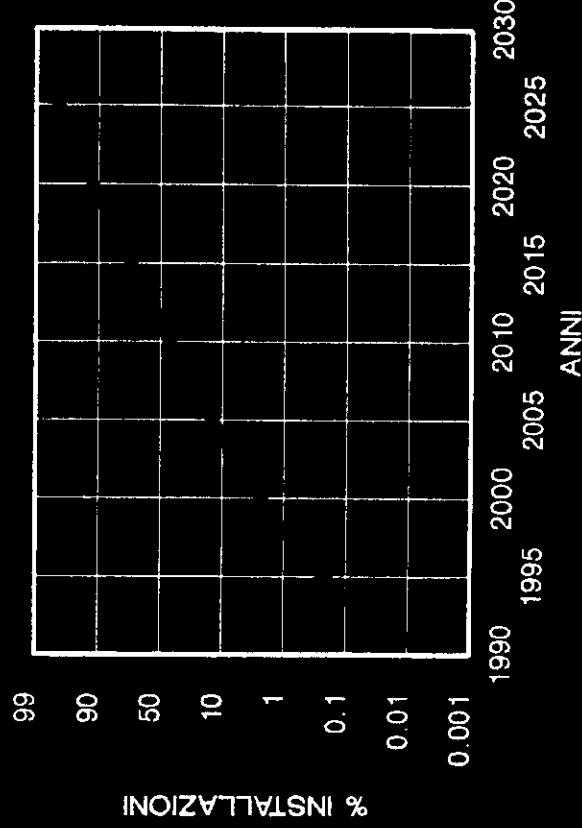
1989

Source: K.M.I.

29952

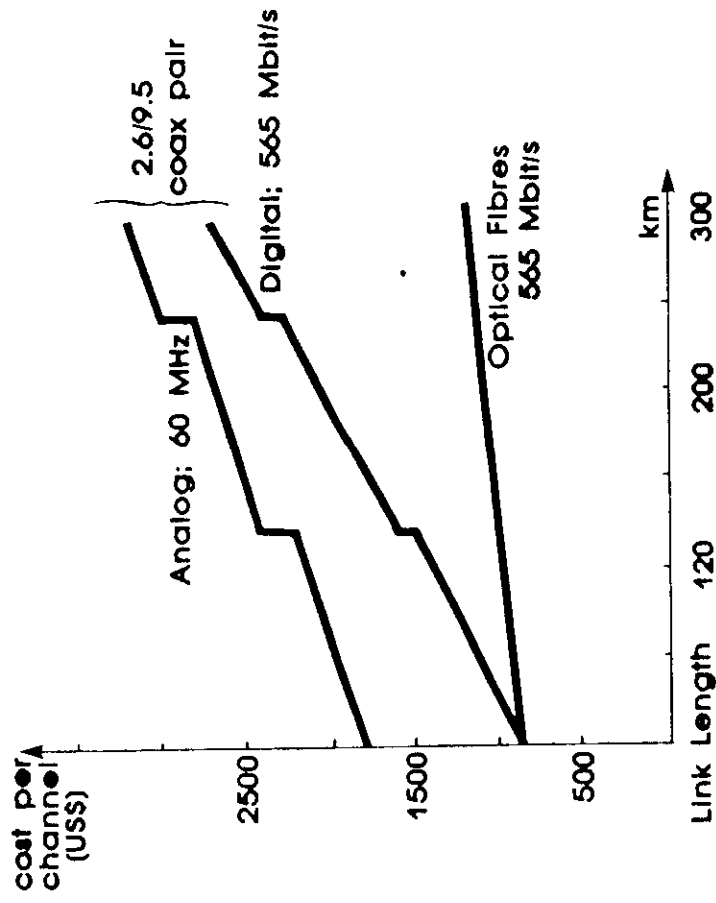
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"OUTLOOK FOR BROADBAND FIBER TO HOMES"



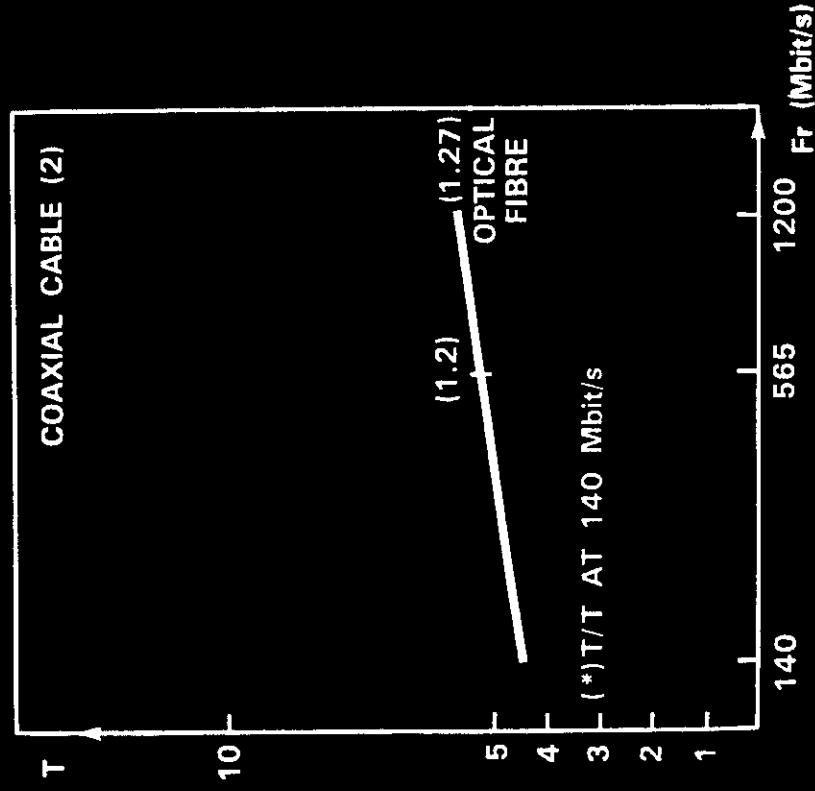
Source : BELLCORE

29968



HSE 23132

NORMALIZED TIME OF UNAVAILABILITY



HSE 24049

COLLEGAMENTI TRANSATLANTICI

	ANNO ATTIVAZIONE	CAVO	CAPACITÀ CIRCUITI (**)	PASSO RIPETIZ. km	NUMERO RIPETITORI
TAT-1	1956(*)	2 x COAX	48	69	51
TAT-2	1959	2 x COAX	48	69	57
TAT-3	1963	COAX	140	37	182
TAT-4	1965	COAX	140	37	186
TAT-5	1970	COAX	845	18,5	361
TAT-6	1976	COAX	4200	9,5	694
TAT-7	1983	COAX	4200	9,5	660
TAT-8	1988	fibra	7560	55	125
TAT-9	1991	fibra	15000	70-80	= 100

(*) Disattivato nel 1979

(**) Senza dispositivi di compressione



OPTICAL SYSTEMS FOR SUBMARINE LINKS

SYSTEM	TAT-7	TAT-8*	TAT-9**
CARRIER	COPPER	F.O. 1.3 um	F.O. 1.5 um
MOD.	ANALOG	DIGITAL	DIGITAL
REP. SPAC. (km)	9	~50	>60
N. LANDS	2	3	5
CAPACITY	4200	(7560)x5	(15120)x5
COST/CIR./YEAR	1700	400	

* 2 x 280 Mbit/s

** 2 x 560 Mbit/s

MAIN INTERNATIONAL SUBMARINE LINKS IN THE MEDITERRANEAN BASIN

NORD
AMERICA

— TAT-9
— MAT-2
— EMOS-1

PALERMO

15

SISTEMI OTTICI SOTTOMARINI TRANSATLANTICI

28698

0 500 1000
Km

BERMUDA

PTAT-4 (1989)

PTAT-2 (1992)

TAT-8 (1988)

TAT-9 (1991)

TATV-1 (1989)

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SISTEMI OTTICI SOTTOMARINI NEL BACINO DEL PACIFICO



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INTRODUCTION OF OPTICAL FIBRES

LONG DISTANCE:

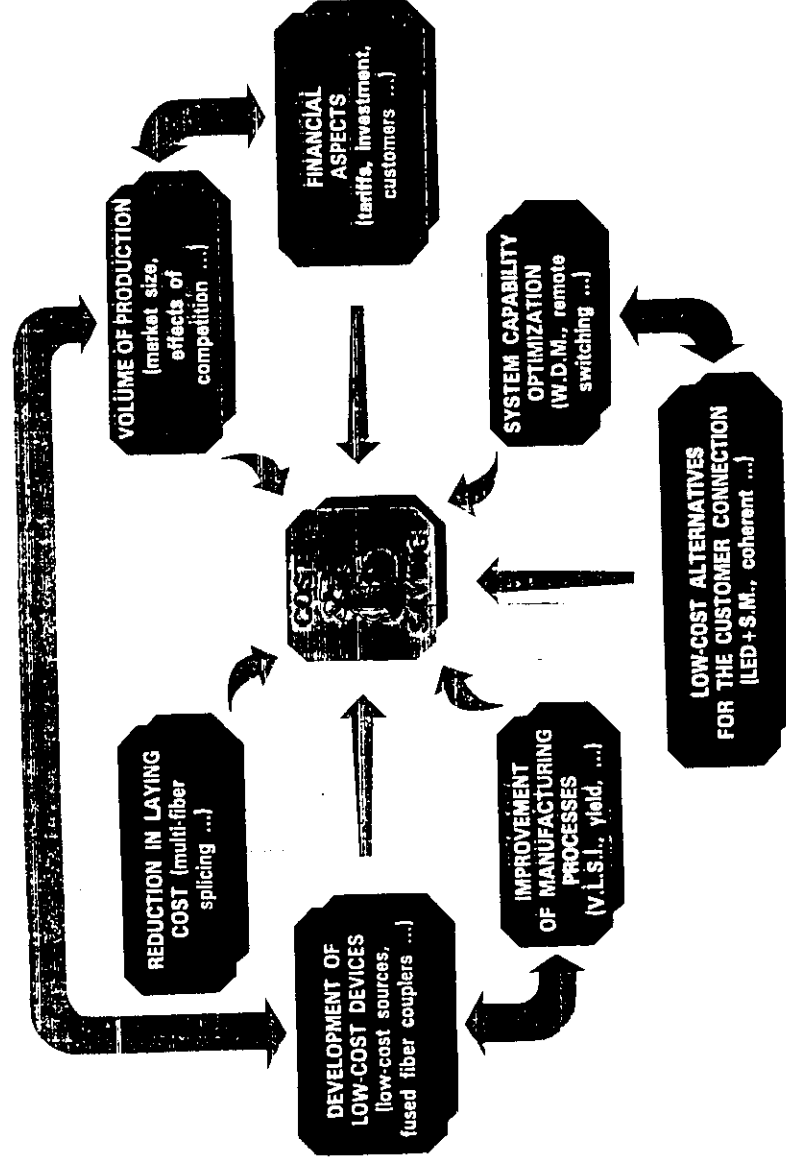
COST AND TECHNICAL ADVANTAGES FOR TELEPHONE SERVICE

DISTRIBUTION NETWORK:

NEW BROADBAND SERVICES

CELEST 23120

18



22837

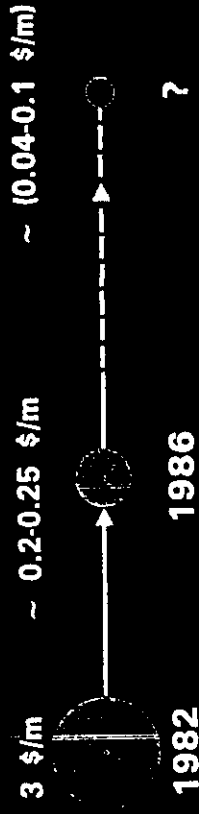
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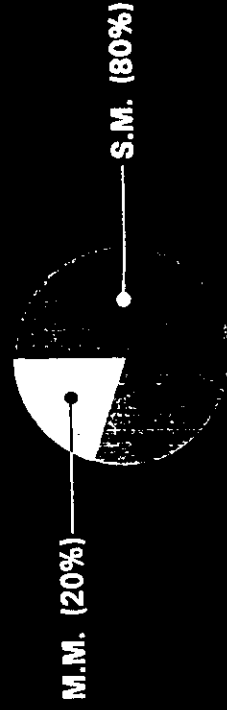
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COSTS AND VOLUME OF PRODUCTION

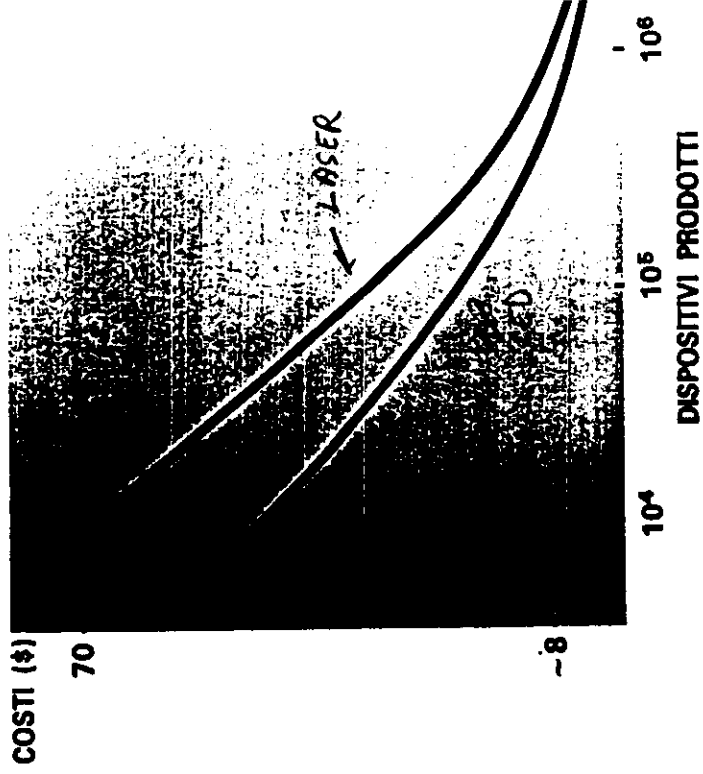
PRICES



MARKET SIZE



COSTI DI PRODUZIONE DELLE SORGENTI OTTICHE

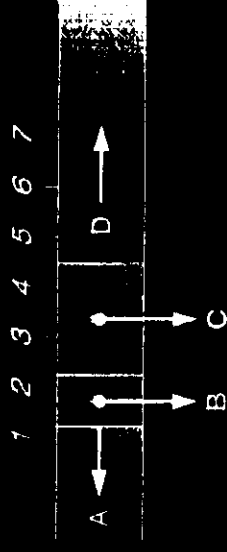


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EVALUATION OF COST-TREND FOR THE MAIN DEVICES OF THE OPTICAL BROADBAND CONNECTION

DEVICE	COST RATIO
Optical Fibres (M.M.-S.M.)	(- - C)
Optical Sources •	
Photodetectors	
Optical Cables	
Copper Cables	
W.D.M. (F.F.)	
W.D.M. (u-optic)	(- - C)
Laying-Installation ••	
Optical (Tx-Rx)	(- - C)
Connectors	
S.M.	
M.M.	
Cost x Splice •••	
Video Codec	

PRESENT
FORECAST



- Cost Differences between LD and ELED < (15%)
- Buried, Aerial or Underground
- For Mass Splicing

ECONOMIC ASPECTS

" MAIN PROBLEM TO BE SOLVED "

COST EVALUATIONS
AND
FORECAST

" AFFORDABLE AND ABLE TO ENSURE PROFITABLE OPERATIONS "

RESULTS OF COST-FORECAST $\cong$ 2000 \$
(for optical broadband connection)

RESULTS OF FINANCE-TARGET $\cong$ BROADBAND TARIFF NOT GREATER THAN
3 TO 4 TIMES THE TELEPHONE TARIFF

HEE L 20832

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FINANCIAL ASPECTS



DOMESTIC CUSTOMER

HEE L 23137

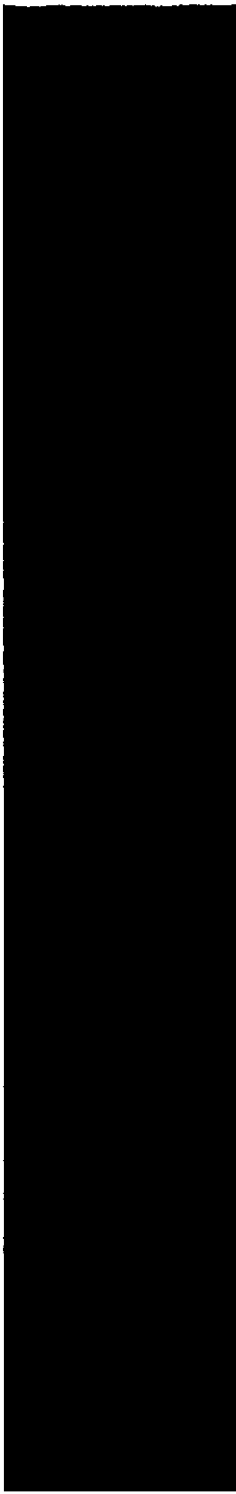
FINANCE-BUSINESS CUSTOMERS

LIMITED NUMBER OF CUSTOMERS
SENSITIVITY NOT VERY HIGH
LINKS IMPLEMENTED WHEN NEEDED
DEDICATED PROJECTS

AFFORDABLE INVESTMENTS - EARLY RETURN

HEEL 23138

25



FINANCE-DOMESTIC CUSTOMERS

VERY HIGH NUMBER OF CUSTOMERS
HIGH COST SENSITIVITY
TARIFF POLICY ORIENTED TO «MAKE THE MARKET»
NETWORK DEPLOYED IN ADVANCE

HIGH INVESTMENTS - LATE RETURN

HEEL 23164

TECHNICAL ASPECTS

Importance of time schedule:

Short term:

use of easily available technology

Long term:

use of optimized solutions
(technically-economically)

CEEL 23129

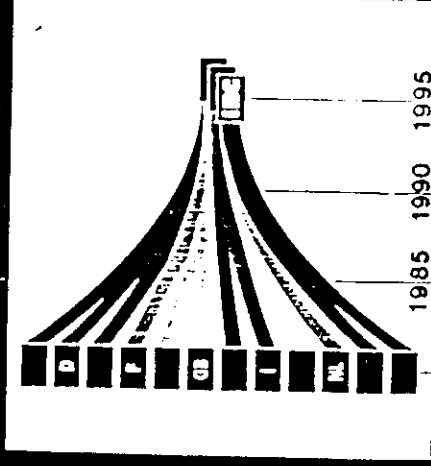
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RACE

RESEARCH IN ADVANCED COMMUNICATIONS TECHNOLOGIES IN EUROPE

AIMS AT MAKING A MAJOR CONTRIBUTION TO THE

"Introduction of Integrated Broadband Communication (IBC) Community wide services in 1995, taking into account the evolving Integrated Services Digital Network (ISDN) and national strategies"



CEEL 28643

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RACE

RESEARCH IN ADVANCED COMMUNICATIONS TECHNOLOGIES IN EUROPE

FACTS

- RACE DEFINITION PHASE 1986 - 1987
- RACE START JAN 1988
- RACE END DEC 1992
- TOTAL RACE INVESTMENT 1.2 billion ECU (*)
- FIRST COMMERCIAL IBC PRODUCTS AND SERVICES 1995

(*) half born by contractors, half supplied by CEC

CEC 23124

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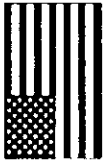
OBJECTIVE

I ntegrated B roadband communication



CEC 23124

EXAMPLES OF EARLY DEPLOYMENT OF THE NETWORK

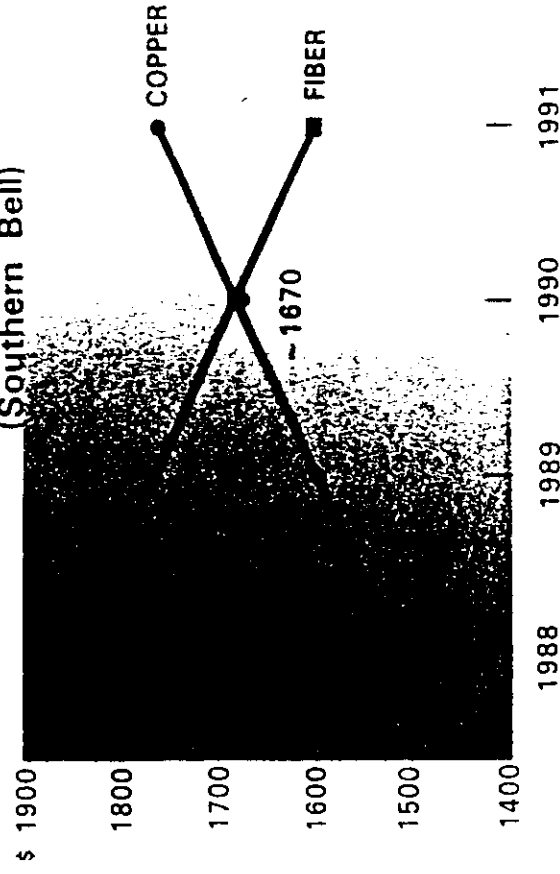
FRANCE :		CATV NETWORKS
F.R.G. :		OPTICAL WIRING OF THE MAIN CITIES
U.S.A. :		EXTENSIVE DEPLOYMENT OF OPTICAL FIBRES DRIVEN EXISTING

REF ID: A723134

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USA 

Fiber '88 Study, Cost Data (Per Living Unit)
(Southern Bell)



Source: Bellcore

25667

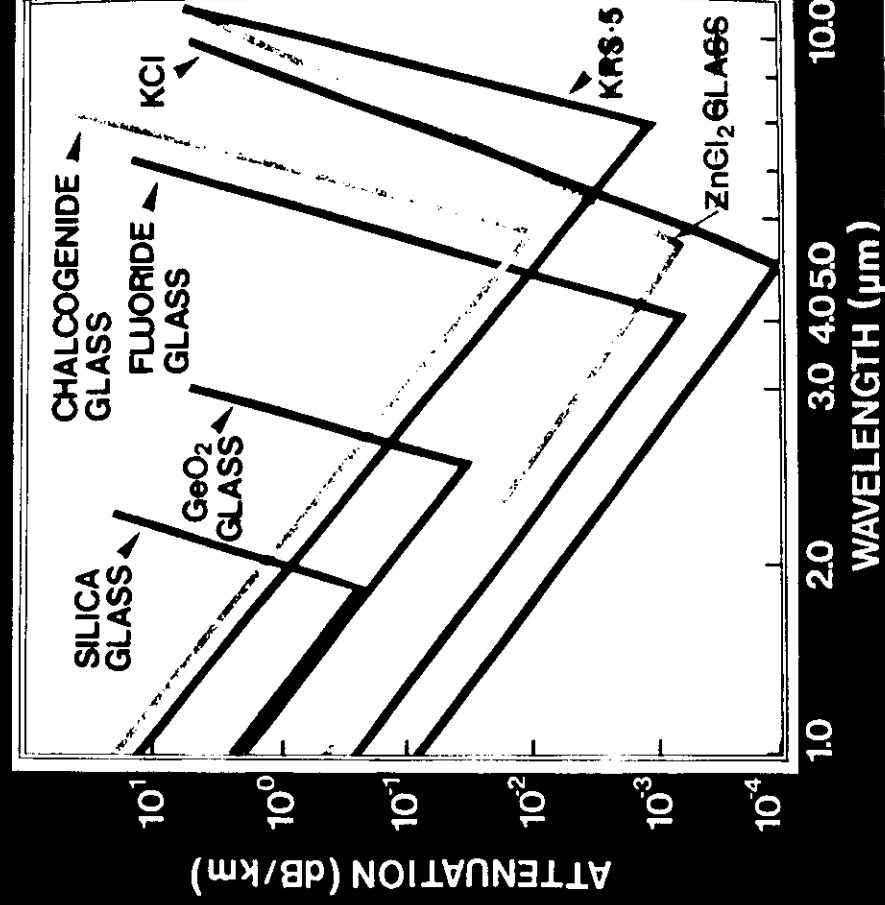


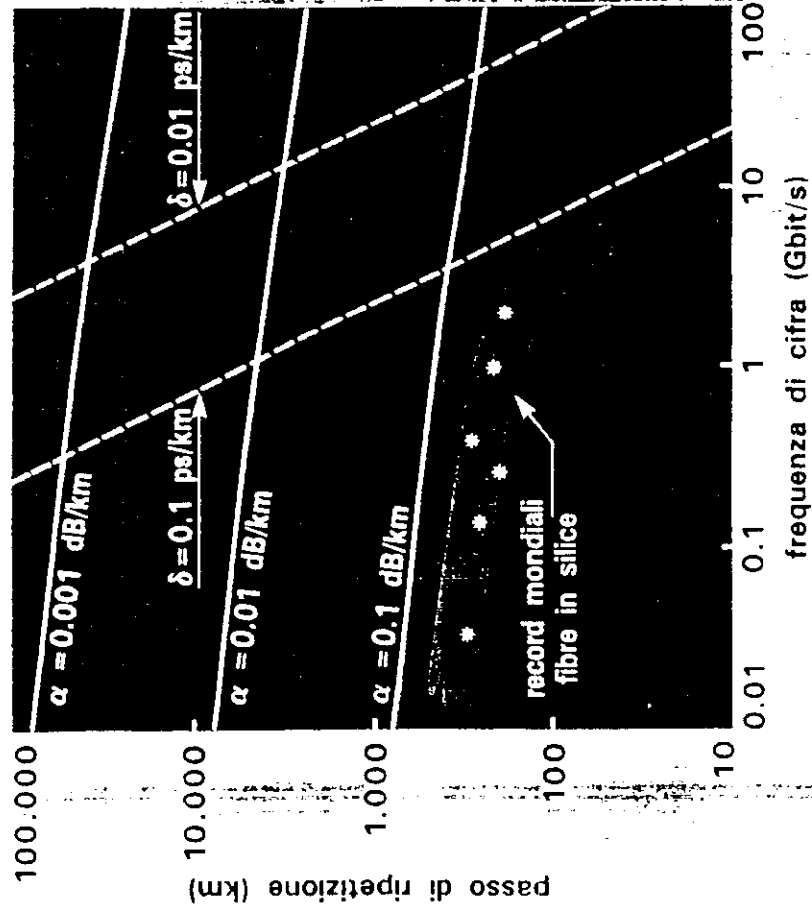
Announced Fiber-To-The-Home Trials (October 1987)

Company	Location	~ Number of homes
Bell South	Hunters Creek, FL	251
GTE	Cerritos, CA	5000
Bell South	Heathrow, FL	500
Mountain Bell	Phoenix, AZ	6800
SW Bell	Leawood, KS	50-100
PNB	San Jose, CA	50-200
		100

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THEORETICAL « V » CURVES FOR DIFFERENT MATERIALS

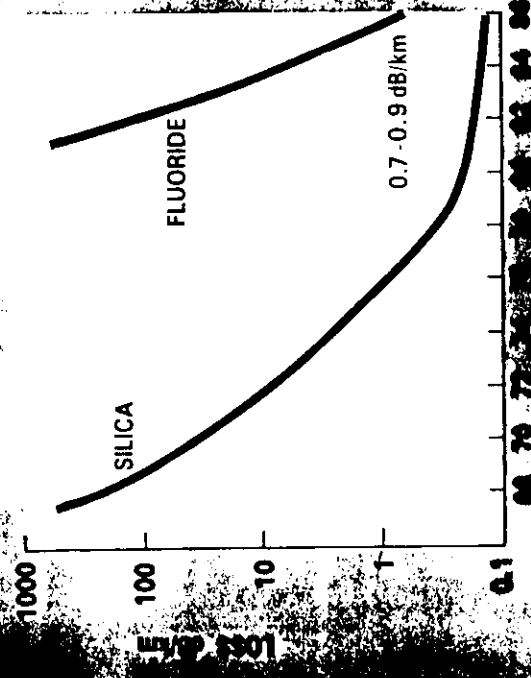




(*) Sistemi coerenti con potenza iniettata di 1 mW e con modulazione 2-PSK
 NB - Il fotorecettore utilizza un diodo P-I-N con prestazioni simili a quelli per NIR

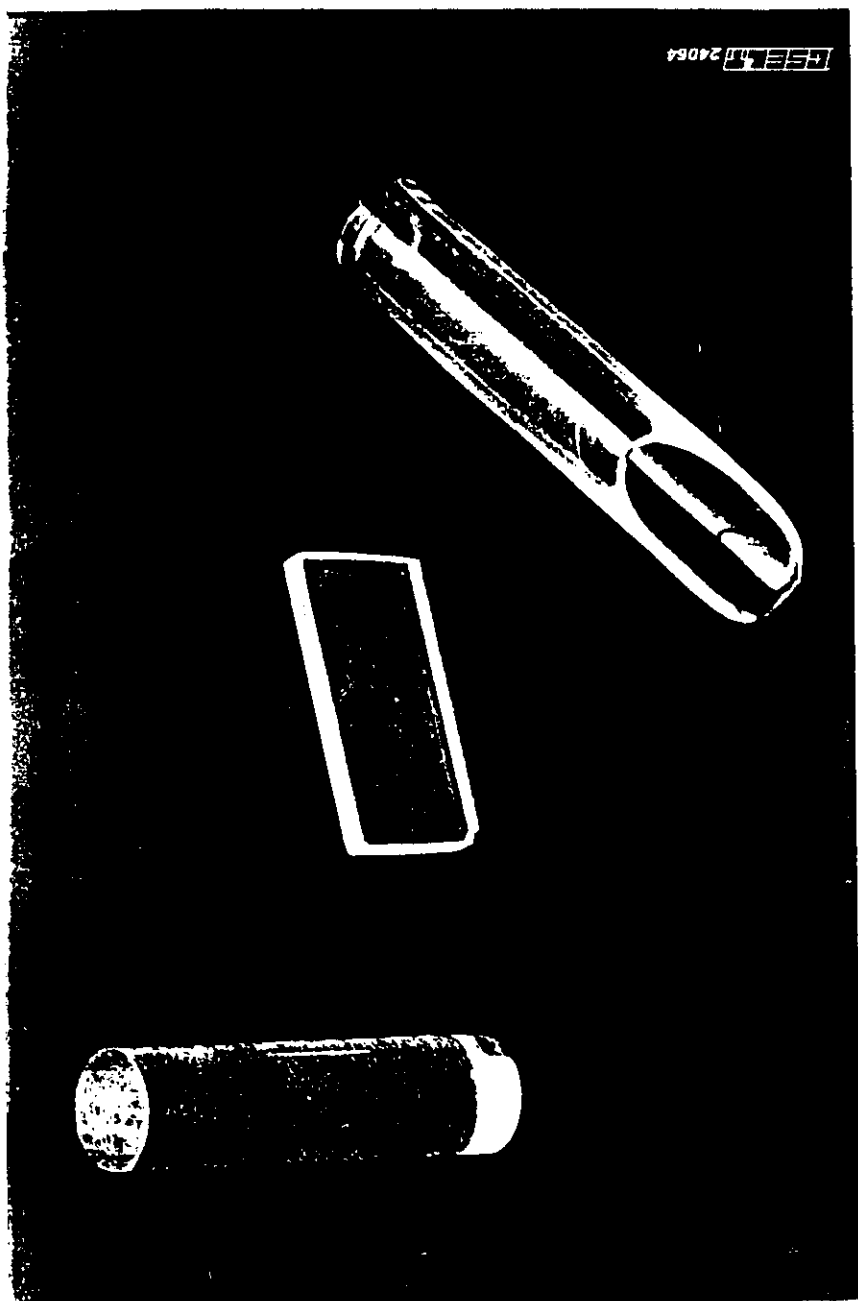
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REDUCTION IN FIBRE LOSS WITH TIME



FEI 27110

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