

Bühlmann Symposium

Diving Medical Research in Zurich 1959 to 1994

Presentation: Thomas A. Bühlmann

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ACHIEVEMENTS IN DIVING MEDICINE 1981-1994

HERITAGE

From father to son: Albert A. Bühlmann -> Thomas A. Bühlmann

ARCHIVES



HERITAGE



Notes of 455 diving experiments



Research agreements

[illegible]

Bühlmann Decompression Tables



Media (daily press, TV, journals)



Publications



Products

ALBERT A. BÜHLMANN

Born 16.5.1923 in Berlin
Humbolt University 1941 - 1944
Immigrated to Switerland 12.1944
Military Service 1946
3 semesters University of Zürich
PhD January 17, 1949
1952 Head Cardio-Pulmonale Lab. University Hospital Zurich
1955 Monograph together with Prof. Dr. P.H.Rossier „Physiology
and Pathophysiology of the Respiration“
1955 about 50 scientific publications
Senior physician reporting to Prof. P.H.Rossier
1959 postdoctoral lecture qualification „venia legendi“
1960 inaugural lecture „Respiration under extreme conditions“
No financial resources



HANNES KELLER

(Foto Hannes Keller)

Born 20.9.1943 in Winterthur
Attended lectures in Philosophy, Physics and Mathematics at University of Zurich
Parttime teacher for Mathematics at Technical School Winterthur
Visionary „World Record in Deep Diving“
Good basic knowledge in Physiology
High self-confidence and highly motivated
Willing to risk health and life
Young entrepreneur qualification
No financial resources

ALBERT A. BÜHLMANN



Motivation:

Deep Diving was unexplored and part of his research field „Respiration under extreme conditions“

Opportunity to obtain international scientific reputation in a field which was dominated by France, UK and US scientists



HANNES KELLER

Motivation:

Reputation and publicity

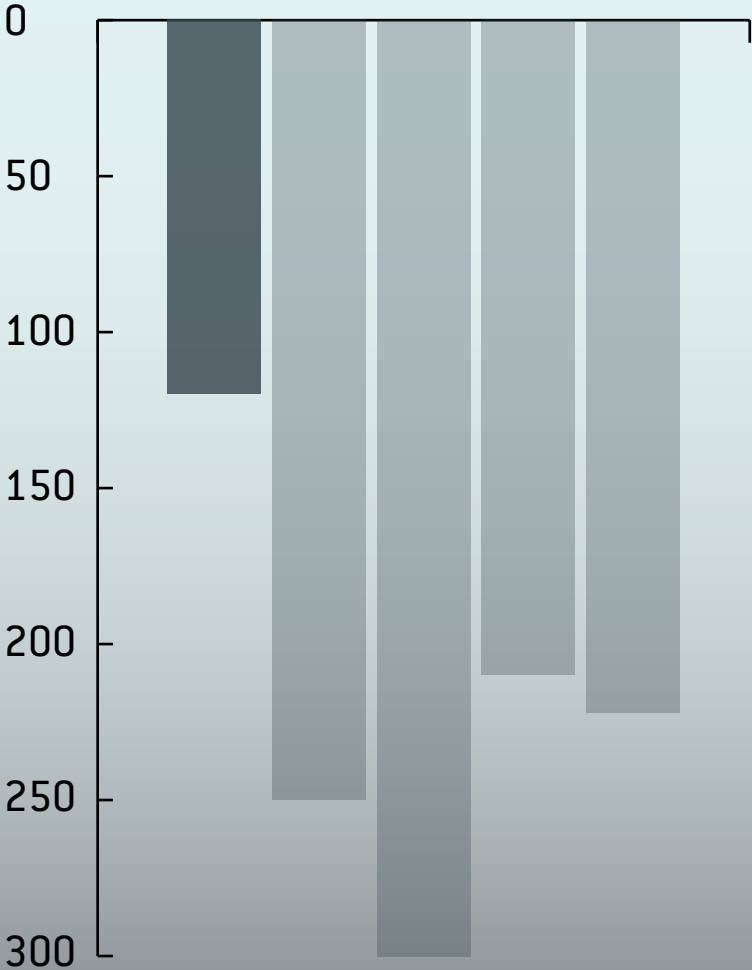
Footprint on the edge of the continental shelf



WORLD RECORD

300 meters in the ocean

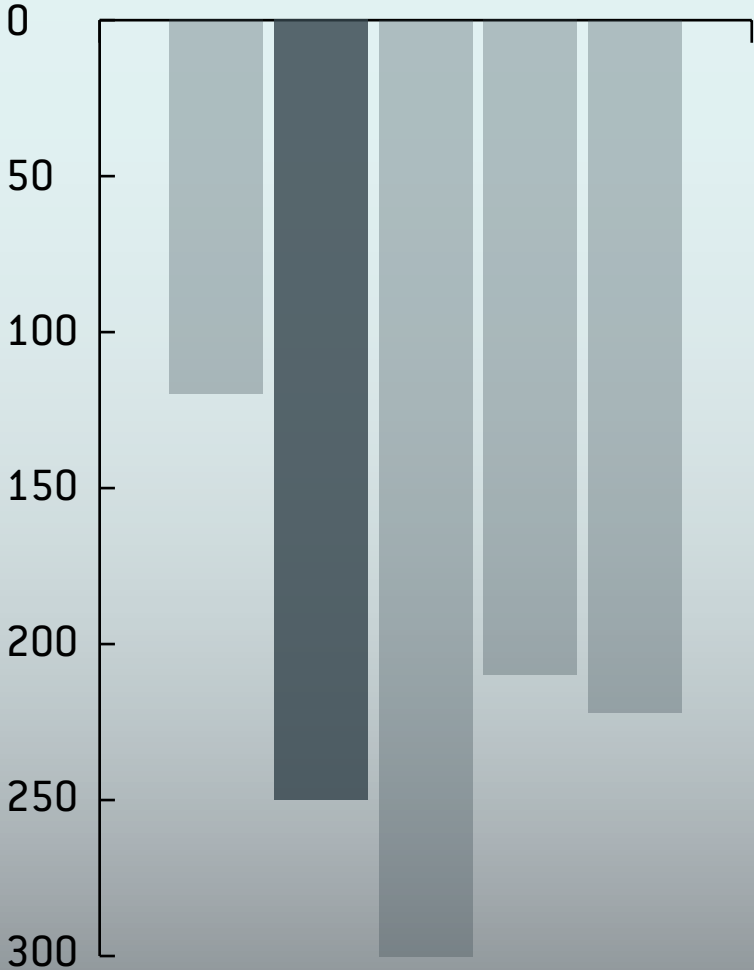
PREPARATION DIVES



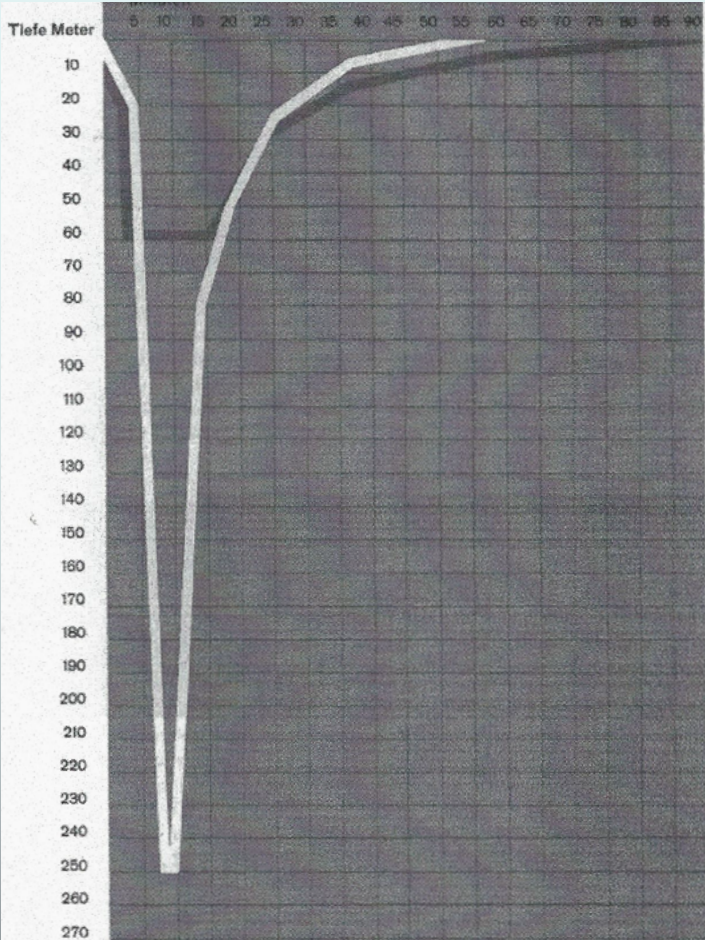
November 21, 1959
120m Zürichsee

(Video)

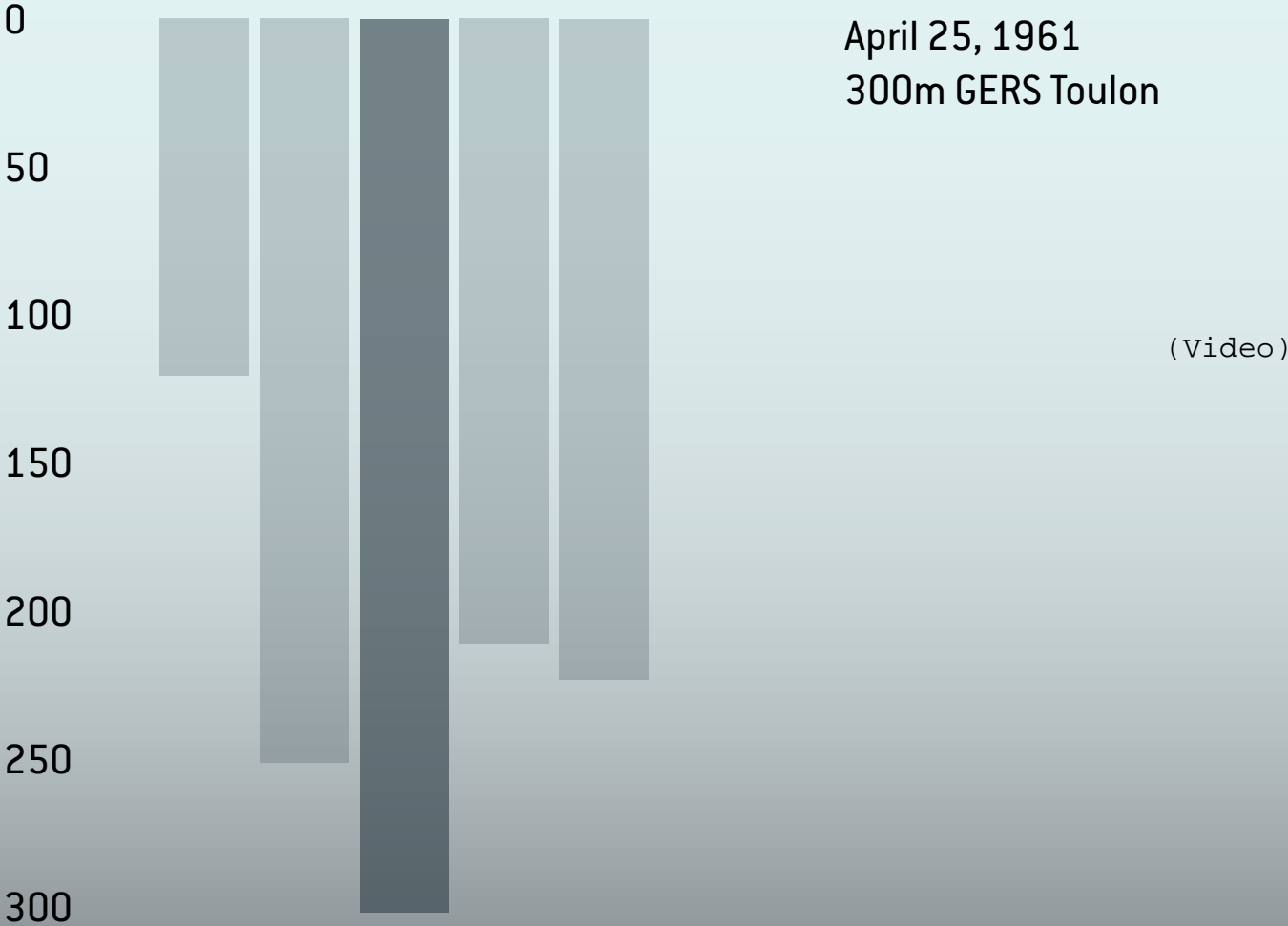
PREPARATION DIVES



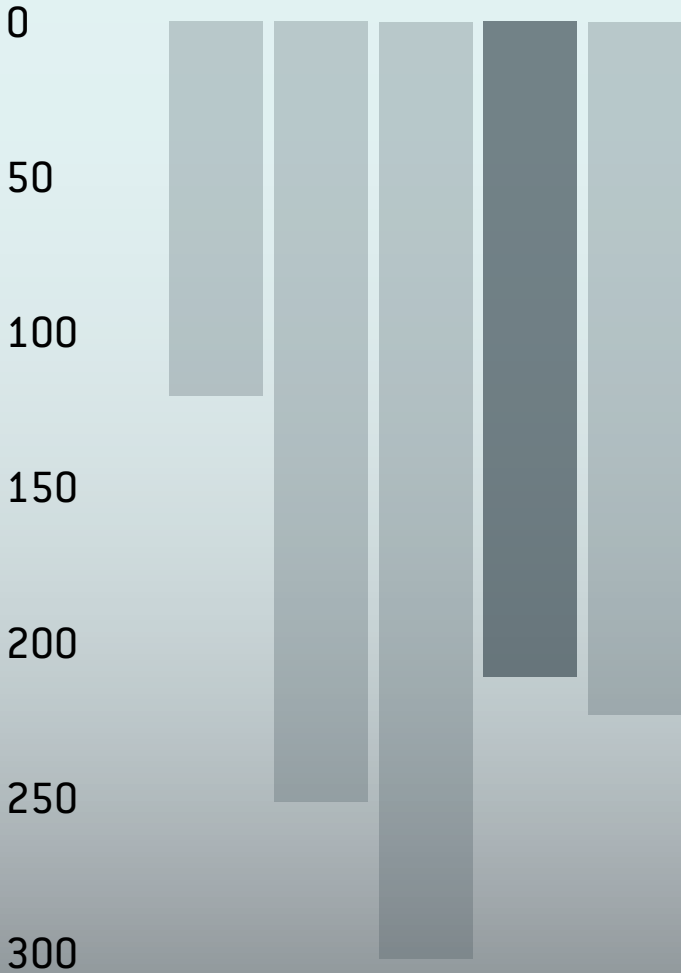
November 11, 1960
250m GERS Toulon



PREPARATION DIVES



PREPARATION DIVES

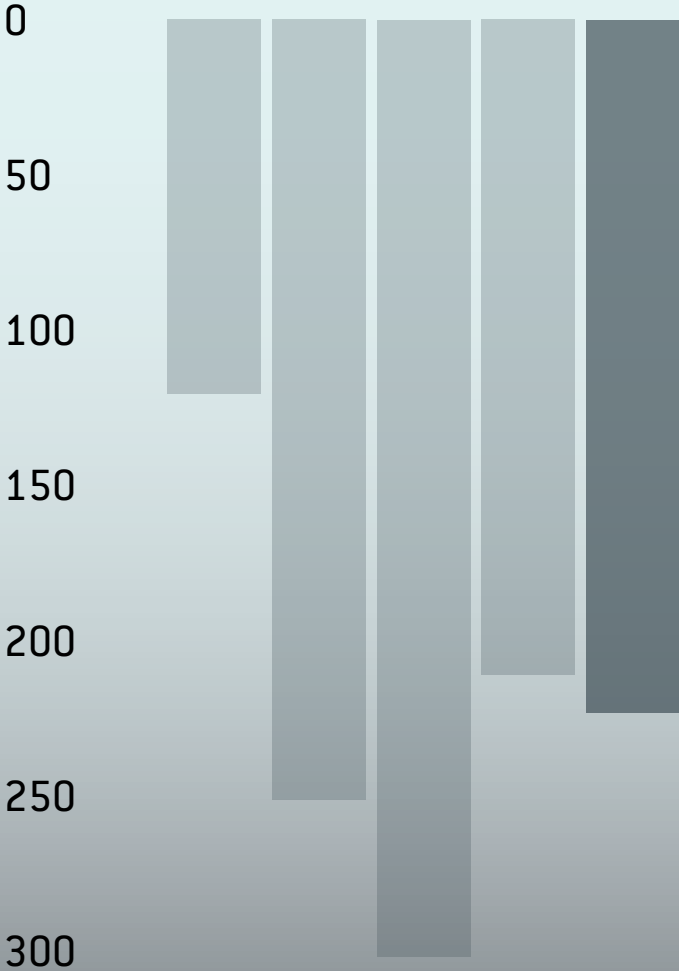


May 10, 1961
210m Washington

(Foto Hannes Keller)

Keller prepares for his May 10, 1961 chamber dive at the United States Navy Experimental Diving Unit (NEDU) Photo: US Navy

PREPARATION DIVES



June 28, 1961
222m Lago Maggiore, Brissago

(Video)

SPONSORS and TECHNICAL PARTNERS



20.12.1961 Ministry of Foreign Affairs
approved sponsoring by US Navy

21.3.1962 Secretary of Education State of
Zurich approved research programm

WORLD RECORD: 300m in the ocean

3.12.1962 Catalina Island, California

Hannes Keller and Peter Small reached 300 meters in the pressure capsule „Atlantis“

Hannes Keller left the pressure capsule and swam a few meters

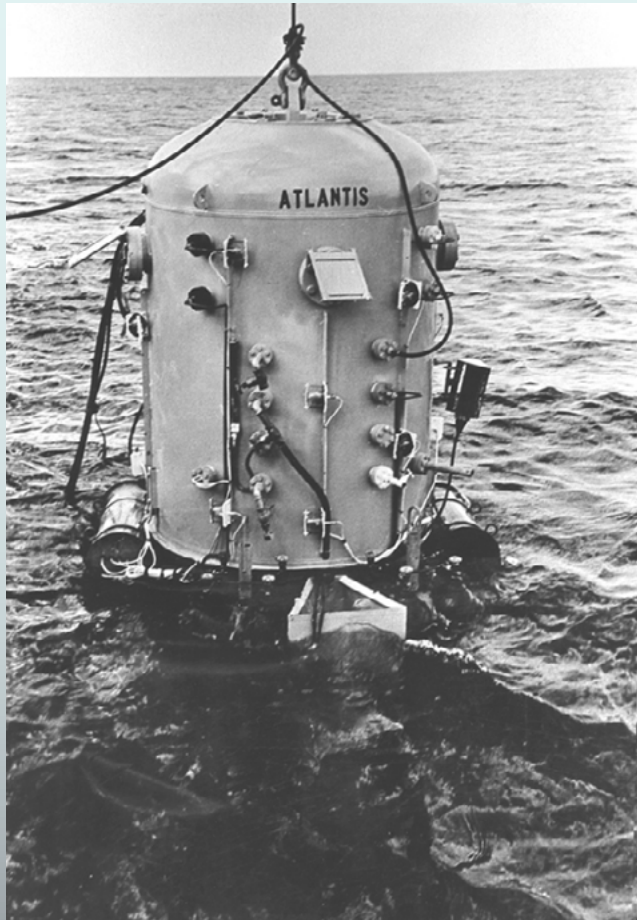
(Video)

During the decompression difficulties arose with the breathing system

Peter Small died because of lack of oxygen

Chris Whittaker, safety diver and friend of Peter Small, died during a rescue action

WORLD RECORD: 300m in the ocean



District Attorney and forensic jurisprudence review the accident

Not causal

Dive profile

Gas mixture

Gas changes

Recompression and decompression

Causal?

Technical defect

Inadequate preparation

Human mistakes

Weather conditions

Stress caused by high media and sponsor attention

Lessons learnt by Albert A. Bühlmann

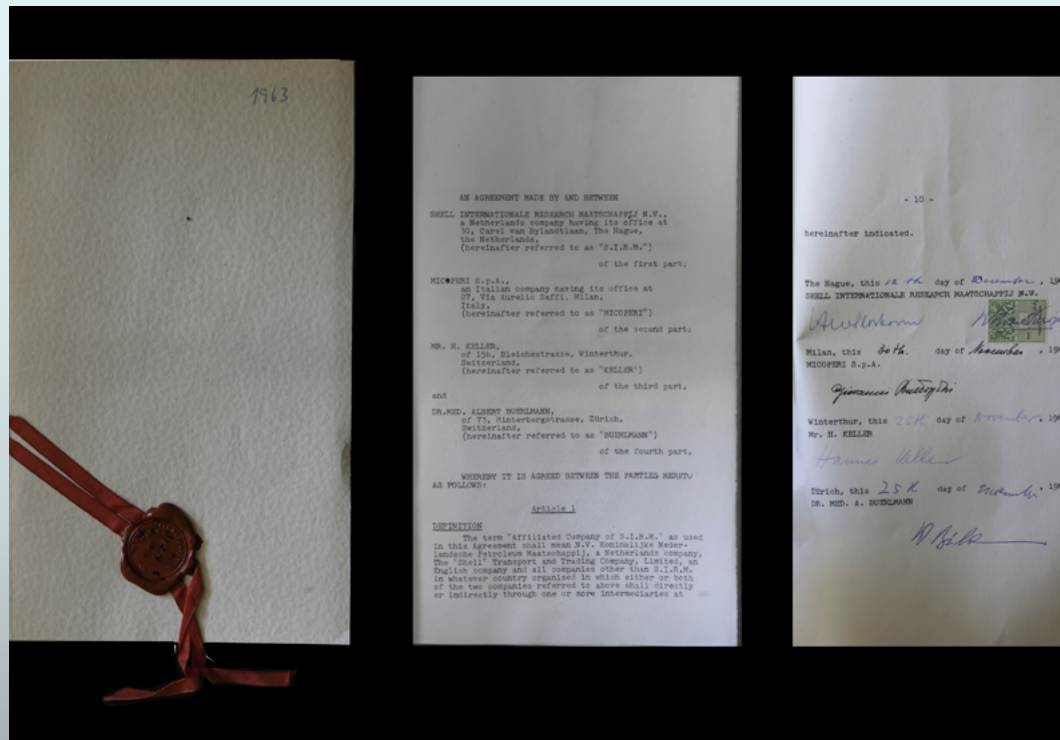
Focusing research programm with volunteers in a laboratory environment integrated in the Medical Clinic of the University Zurich

Practical implementation of reseach results under natural conditions to be done by experienced and specialised firms

CAP SHELL PROJECT

Cooperation with Shell International and Micoperi/ IT

COOPERATION with Shell International and Micoperi/IT



M I C O P E R I

Research and Consultancy Agreement

signed 11.1963 between Shell International Research Maatschappij,
Micoperi S.p.A., Hannes Keller and Albert A. Buhlmann

Joint Company established

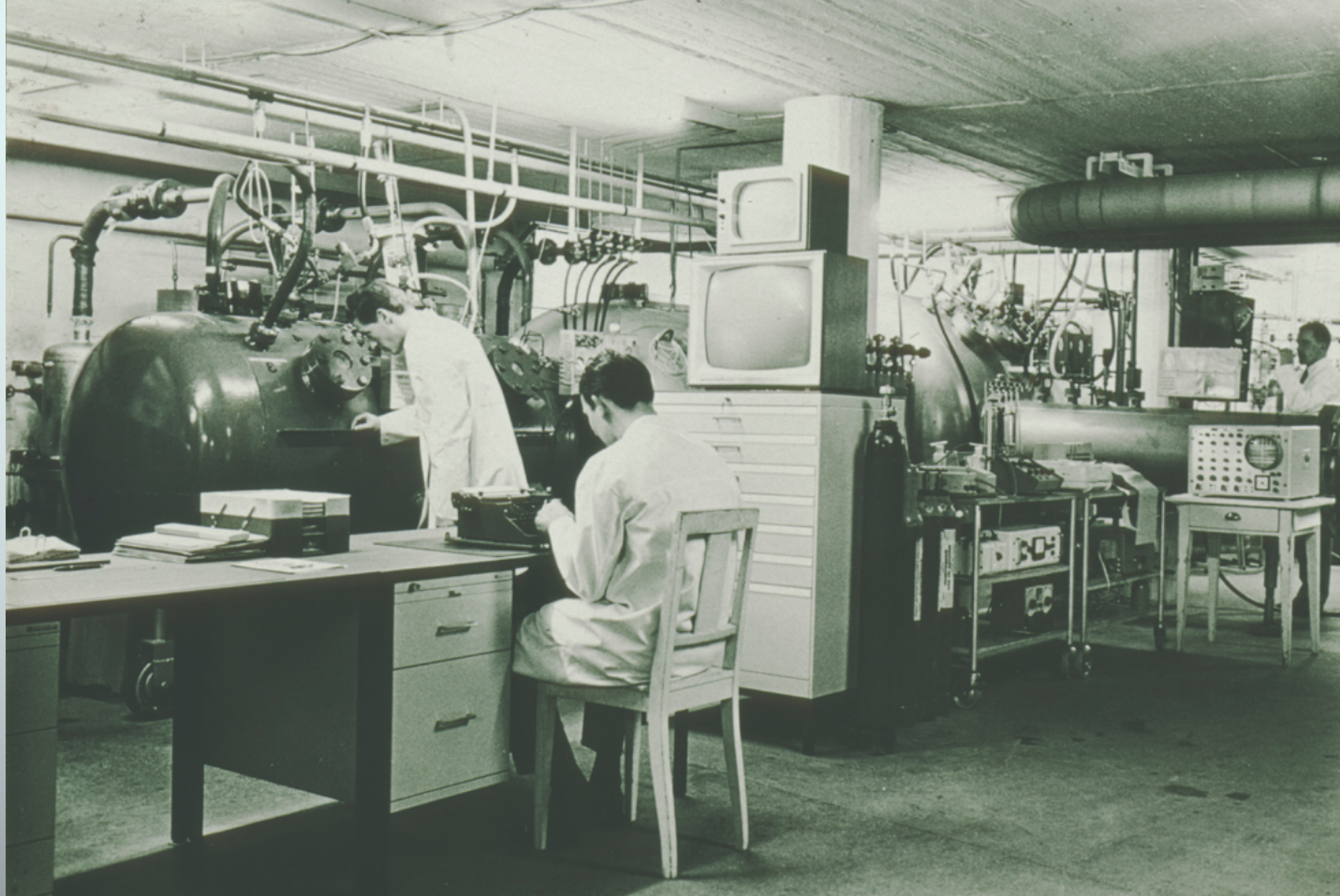
Contract parties as shareholders with the scope commercialisation of
intellectual property rights

COOPERATION with Shell International and Micoperi/IT

Research Objective:

« Development of commercially applicable procedures, techniques and equipment to enable free divers to reach and work safely and effectively at water depths of up to 700 meters. »

COOPERATION with Shell International and Micoperi/IT



103 experiments in Zürich
as preparation for Cap Shell
project between September
9, 1964 and May 3, 1966

CAP SHELL TRIALS Porto San Stefano/ IT 1966



**September 14, 1966 until
October 20, 1966:**

Prolonged exposures to helium-oxygen
mixtures at depths of 30 and 220 meters
4 to 6 hours at depths of 220 meters
Duration of trials up to 4 days

Zurich provides:

trial profile

gas mixture

time of gas changes

recompression and decompression procedures

Shell and Micoperi are responsible for:

Design and construction of pressure capsule

logistic

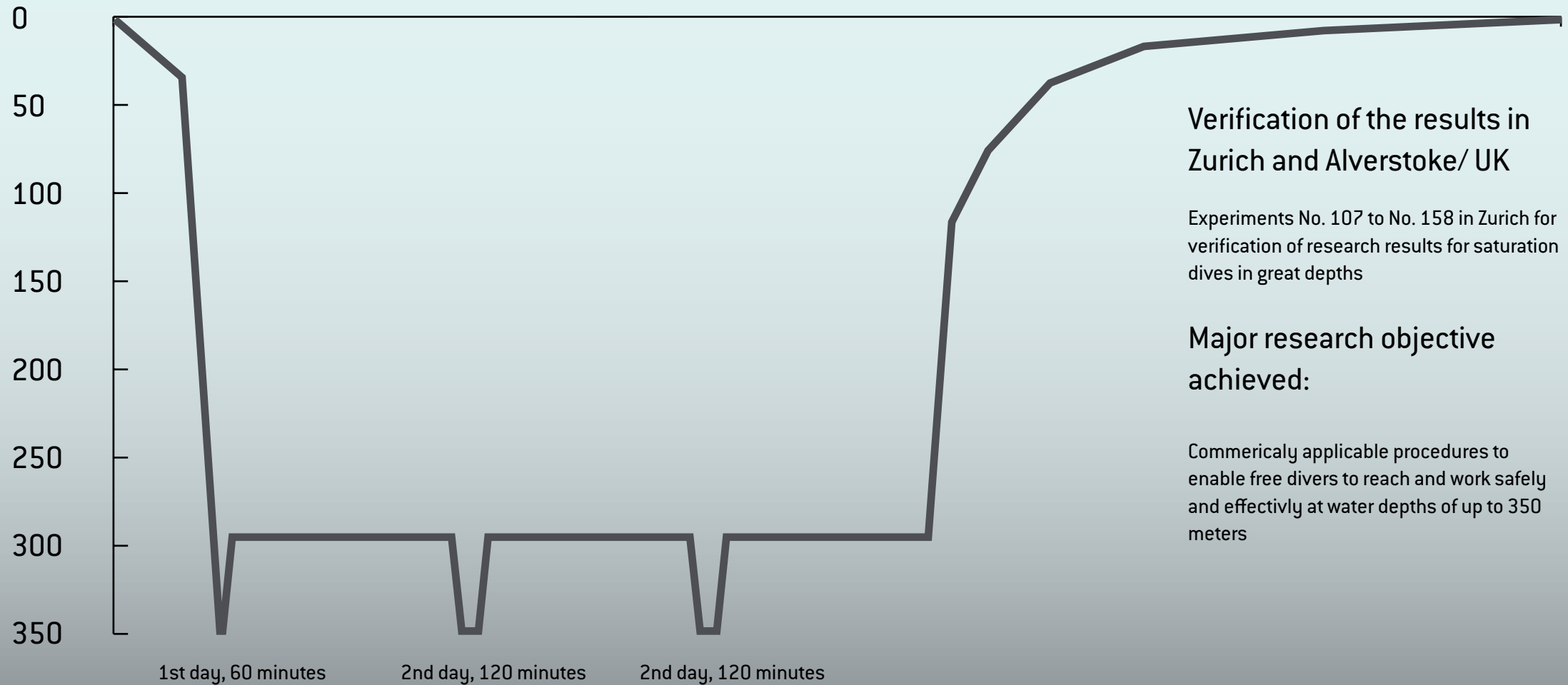
Execution of trials

Risk management and safety procedures

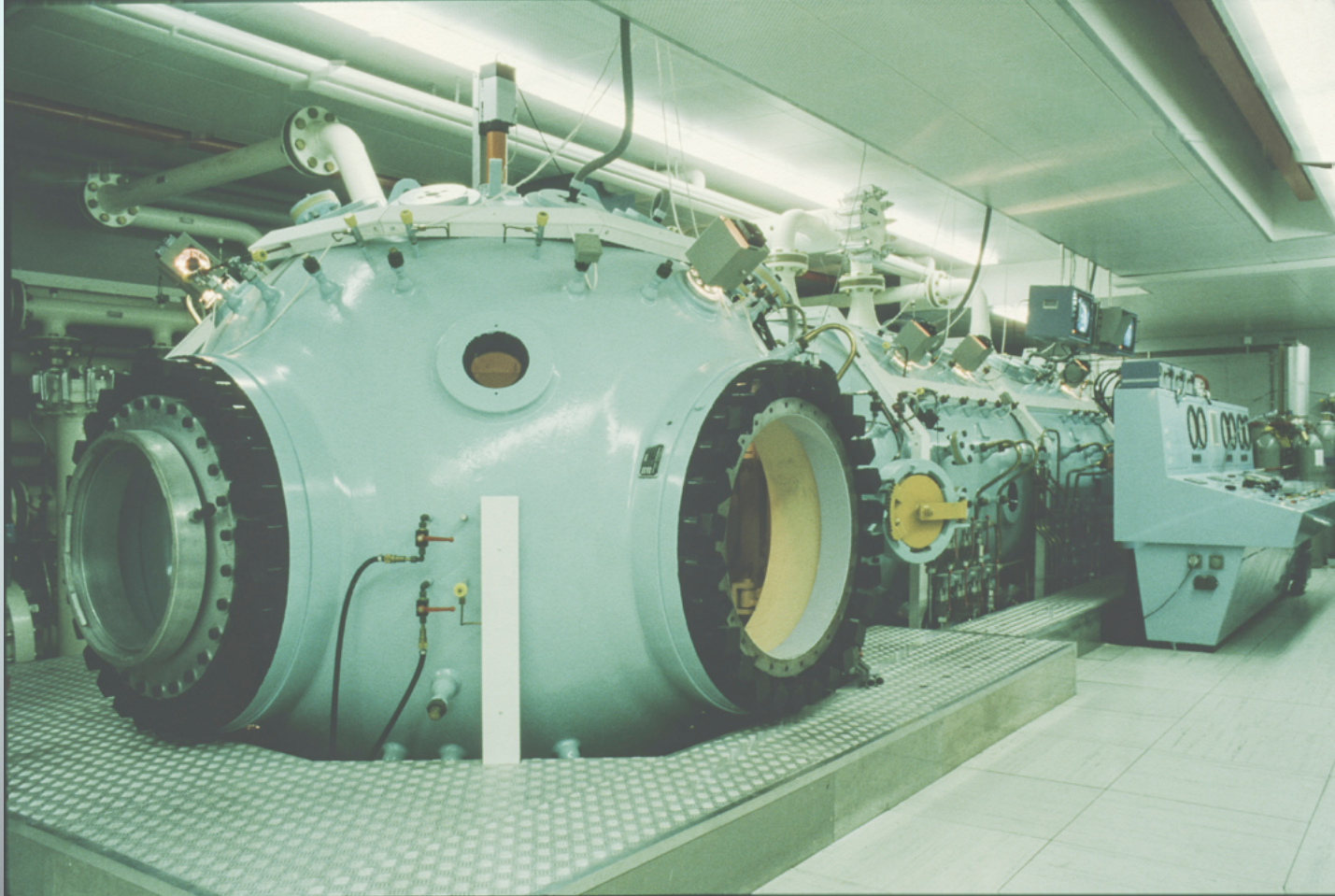
Comment Albert A. Bühlmann:

„Thanks to the circumspect direction of Commander John Carr (Shell), these „Capshell trials“ passed without serious incident“

VERIFICATION



NEW PRESSURE CHAMBER IN ZURICH



1970

On November 12, 1970 the Gouvernement of State of Zurich approved a contribution for the new pressure chambre under consideration of the extraordinary research results delivered by Albert A. Bühlmann and Hannes Keller and the expectation that the Zurich Lab will keep the extraordinary position in the future.

1975

Zurich had upgraded their Lab to the standard of Medical Diving Centers in the France, UK and the US

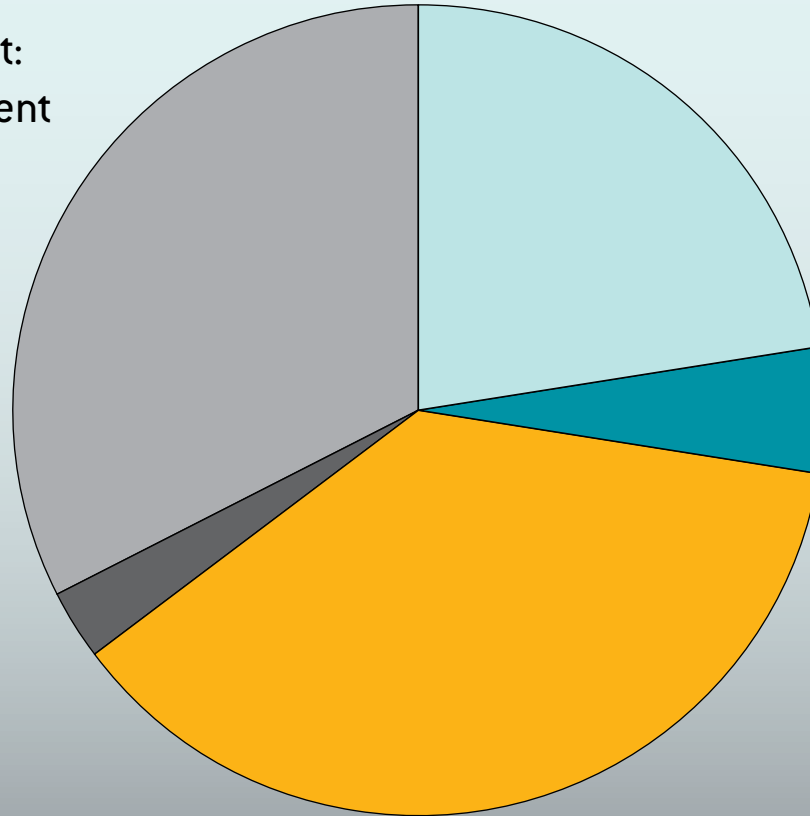
November 27, 1975

First experiment (no. 258) in the new chamber at the University of Zurich

NEW PRESSURE CHAMBER IN ZURICH

Additional subsidies during project:
State of Zurich, Federal Government
and Shell International
CHF 930'000

Albert A. Bühlmann
CHF 84'946



Gouvernement of State of Zurich
CHF 650'000

Federal Government (Military Department)
CHF 150'000

Shell International
CHF 1'065'260

RESEARCH PROGRAMM UNTIL JUNE 30, 1981

135 experiments from November 27, 1975 to June 30, 1981

Highlights High Pressure Exposures

June 22-24, 1977 500 meters

January 28-February 1981, 575 meters

High Pressure Nervous Symptome

No symptomes 350 meters Alverstoke 1969

Strong symptomes 500 meters 1977

Less symptomes 575 meters extension of compression phase Zurich abstains of adding N2, 1981

Research Agreement with Shell and Micoperi ended as of June 30, 1981

Conclusions for Albert A. Bühlmann:

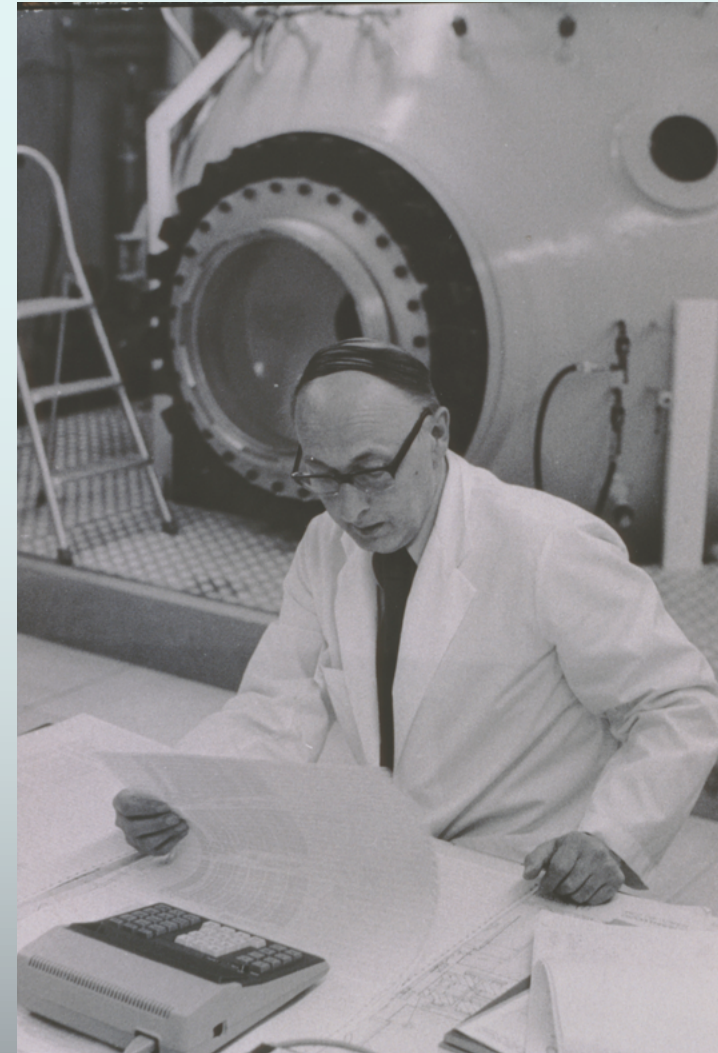
End of cycle for new extraordinary research results for diving in great depth

New technology (robotics) will replace professional human diving

Principle for subsidiarity for experiments in great depth

New fields of research to be found

New financial sourcing for future research programm



1982-1994

PUBLICATIONS, DEVELOPMENT OF DIVING MEDICIN AND DIVING COMPUTERS

NEW RESEARCH PROGRAMM

Albert A. Bühlmann's new research program

Extending experimental data for dives to 30 meters in combination with different gas mixture

Improving mathematical model for decompression calculation

New decompression tables

Extending experimental data for dives in the mountains up to 4500 meters

Developing mathematical models for use in decompression computer

Publication of results of 24 years of research in Zurich



ACHIEVEMENTS IN DIVING MEDICINE 1981-1994

1981-1985

1981 last deep dive experiments in Zurich

Experiment no 374 up to no 455 (30 meters, Air and mixture with helium)

September 11, 1985 last diving experiment in the pressure chambre

1983 monograph „Decompression, Decompression Sickness“ in German

1984 monograph „Decompression, Decompression Sickness“ in English

Contract with Rolex Watch

Cooperation with Divetronic



ACHIEVEMENTS IN DIVING MEDICINE 1981-1994

1986

Albert A. Buhlmann supports Jürgen Hermann/Divetronic Ltd. regarding the development of Deco-Brain P2

Announcement of the „Bühlmann Decompression 86“ tables

Diving trials Lago di Lucendro

begin of the collaboration with Dynatron and Uwattec

1987

Announcement of „Aladin“

Diving trials Lake of Titicaca

1988

Announcement of „Aladin Pro“

Diving trials Lago di Lucendro, Lake Mutt and Lake Mount Kenya

1989

New tables for Caisson Work in Switzerland issued by SUVA

1990

Albert A. Buhlmann retired, last lecture

„Circulation and Respiration under extreme conditions“

2nd edition of „Tauchmedizin“ with chapter

„Decompression Computer“ from Ernst Voellm

1993

3rd edition of „Tauchmedizin“

1994

Announcement of Aladin Air X and calculation model ZH-L8 ADT in Düsseldorf



The image shows two diving decompression tables. The left table is yellow and titled 'Bühlmann Decompression 86' with a depth range of 101-2500 m. The right table is blue and titled 'Bühlmann Decompression 86' with a depth range of 0-750 m. Both tables contain detailed tables of decompression times for various depths and ascent rates.



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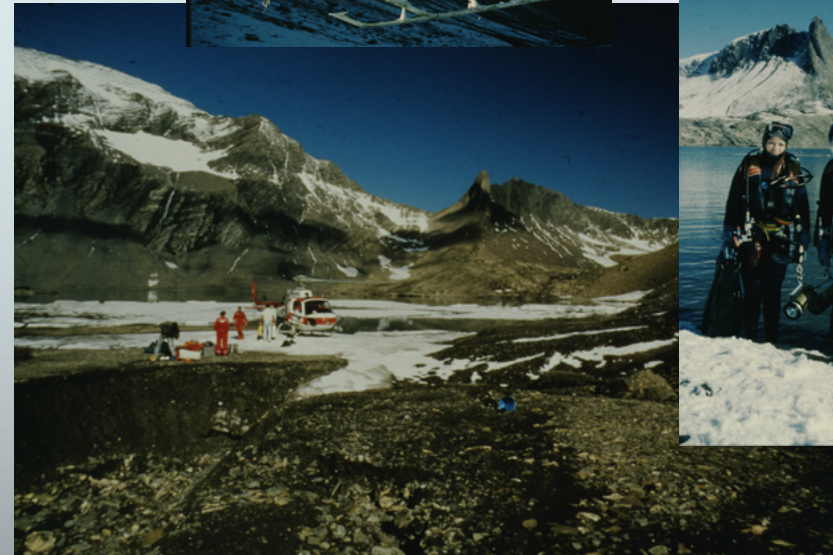
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suva



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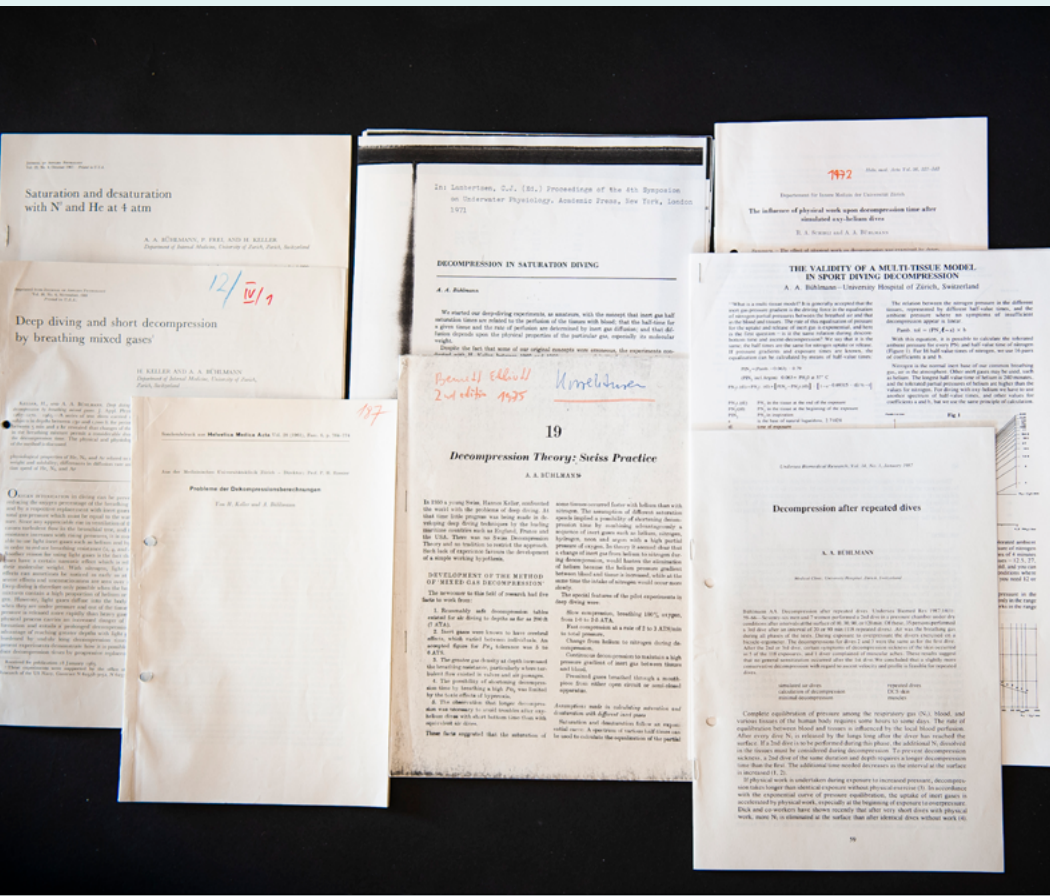
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Historisches Seminar der Universität Zürich; Master Applied
History Professor Dr. Tobias Straumann

Masterarbeit von
Thomas A. Bühlmann, Zürich

Die Tauchmedizinische Forschung an der Universität Zürich von 1959 bis 1994

Albert A. Bühlmann und sein Wirken

Thank you.