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Main results of scientific technical cooperation " Development of Neurological Approaches to the Study of Acute and Chronical Effects of Microgravitiy on the Human Body".

N O V E M B E R 1 9 9 0

PARTICIPANTS

Univ.Klinik f.Neurologie Innsbruck	IBMP Moscow
Scientific supervisor:	
Univ.Prof.Dr.F.Gerstenbrand	Prof.Dr.I.B.Kozlovskaya
Principal investigator:	
Univ.Doz.Dr.M.Berger	Dr.N.Burlachkova
Dr.M.Marosi	Dr.A.Sokolov
Dr.A.Muigg	Dr.M.Belyaeva
Dr.T.Melichar	Dr.B.Babaev
Dr.E.Karamat	Dr.M.Borisov
Dr.R.Schauer	Ing.V.Masalov
Ing. E.Baldauf	
Ing.H.Gragger	
Ing.E.Gruber	

CONTENTS

2. INTRODUCTION

The agreement on scientific- technical cooperation "Development of neurological approaches to the study of acute and chronic effects of microgravity on the human body" between the IBMP Moscow (USSR) and the Neurological Clinic of Innsbruck (Austria) will finish at the end of 1990.
The main purpose of this agreement for this period of time was to work out principles of neurological control systems and to develope new methods to study and to assess the central nervous functions and motor control systems in microgravity.

To fulfill these tasks three series of joint experiments in the simulated microgravity of the" dry" water immersion model was performed. The data obtained during the experiments revealed the wide spectrum of neurological alterations, which in clinical terms are denoted as pathological. In previous studies soviet specialists showed analogue alterations such as hypotonia and hyporeflexia etc. The analysis of our data by Soviet and Austrian specialists suggest that these changes are functional.

In some cases the signs and symptomes occuring during the stay in dry water immersion may be compensated microlesiones of the CNS, decompensating in altered gravitational environment.

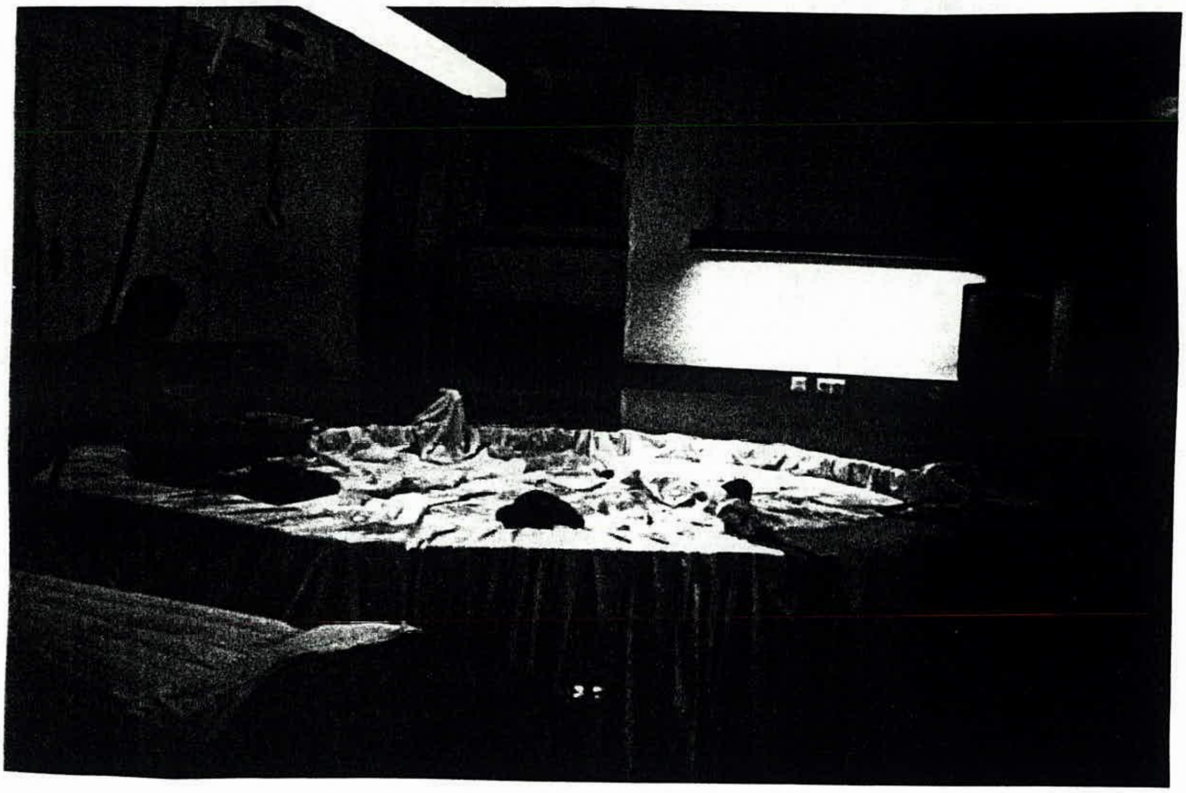
This may led to the suggestion to use this method of dry water immersion for detection of subclinical symptoms.
During the joint experiments neurological alterations have been found by neurophysiological and clinical neurological methods.

According to the main tasks of the agreement a special equipment has been worked out to use it as a objective method for movement measurements of eye, head and upper limbs in response to visual and acoustic cues. Thus this system investigates the integration mechanisms between different sensory systems.

The "know-how" to measure neurological and neurophysiological changes during simulated microgravity was contributed by the Soviet side. The software and hardware for these investigations mentioned above were developed by the Austrian specialists.

As a consequence of this cooperation a " dry" water immersion model laboratory has been established in the neurological clinic of Innsbruck. During the investigations in the water immersion model the effectivity and high resolution of the equipment, used to measure altered movement pattern has been proved. A computerized neurological check list was worked out to make possible a comparison of the course of alterations and also to permit reproduceability of investigations.

The results of this cooperation obtained till now confirm the actuality of these scientific questions and show the necessity of continuation ofthis research.



The immersion basin at the Innsbruck Microgravity Laboratory

3. MATERIALS AND METHODS.

3.1 Tasks of the cooperation.

Detailed studies of the central nervous functions and motor control systems pre, after and during simulated and real exposure to microgravity should take place by using the aid of methods and the technical equipment developed and used in the University Clinic of Innsbruck as well as procedures used by the partners of the IBMP..

Part of this movement recording system (MRS) is also a special device to measure the T-reflex (quadriceps muscle). By using this equipment the above mentioned hyporeflexia,altered thresholds etc. can be documented in a very precise,standardized and reproduceable way.

The clinical neurological changes caused by simulated microgravity and especially the course of these symptoms occuring during the stay in immersion have to be objectivated also in a reproducable and comparable way.

3.2 Austrian part

The MRS complex requires a special hardware and software system to measure standardized movement pattern of head,eyes and arm (Fig.1). Aiming and following movements are recorded.

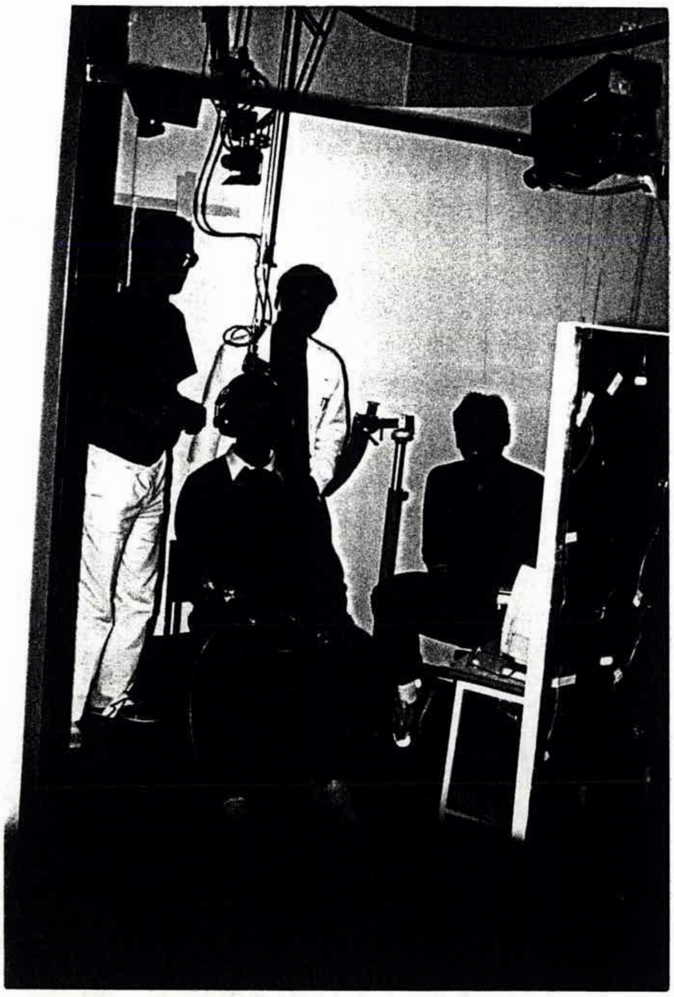


Fig.:1 the MRS complex

standardized movement pattern:

a. Optic signals are presented by LED matrix (95 X 95 cm) with 32 LEDs, facing the subject at a distance of 1.60 m.(Fig. 2).

Fig.:2 the volunteer facing the LED matrix

b. Localizable acoustic signals are presented by special headphones

c. For the standardized head movements the subject has to aim at the LEDs, illuminated in a standardized pattern, by using a focussed light beam of a helmet fixed lamp (Fig.3).

Fig.: 3 volunteer using focussed light beam of a helmet fixed lamp

d. The standardized arm movements are carried out in a similar way also using the light beam of a "gun like" lamp beeing attached to the subject's arm (Fig. 4).

Fig.: 4 gun like lamp beeing attached to the subject's arm

e. The eye movements are recorded by electrooculography (EOG)
The task of the subject was to fix the visual target.Doing so the combined movements of eyes and head will be measured. The pattern of LEDs presentation is standardized.

The investigation program of the MRS complex takes place as follows:

1	-aiming eye movements to acoustic stimuli	presented
2	-aiming head movements to acoustic stimuli	by
3	-aiming arm movements to acoustic stimuli	headphones

4 -aiming eye movements to visual stimuli
5 -aiming eye and head movements to visual stimuli
6 -aiming arm movements to visual stimuli

7 -tracking eye movements
8 -tracking head movements
9 .-tracking arm movements
10.-passive arm movements
11.-active arm movements
12.-memory-tracking arm movements
13.-neck reflexes
14.-active head movements (flexion and rotation)
with closed eyes

4 to 13 - stimuli presented at the LED matrix

f.T-reflex.
In a standardized and fixed position and at variable standardized impacts the extent of movements of leg and the EMG activity of the quadriceps muscle were registrated (Fig. 5, 6).

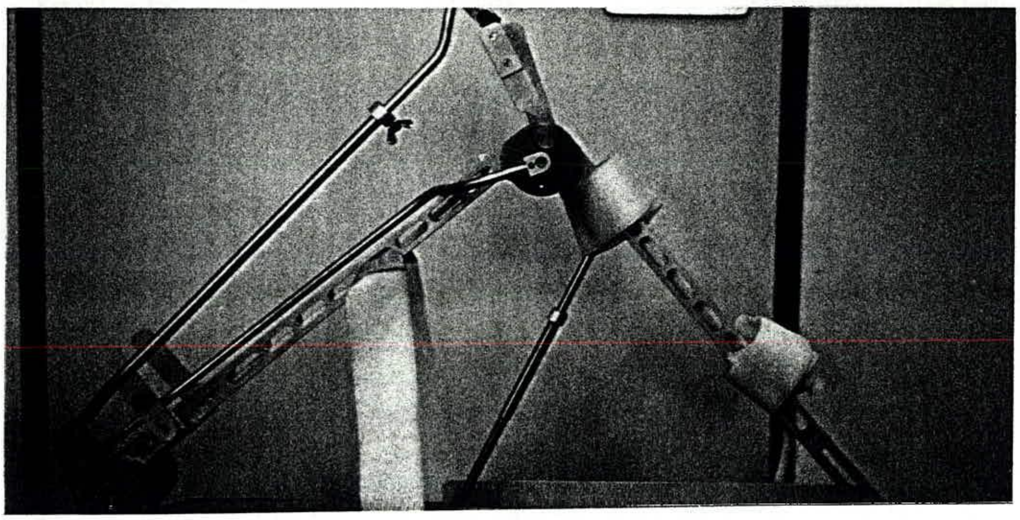


Fig.: 5 equipment to measure T-reflex

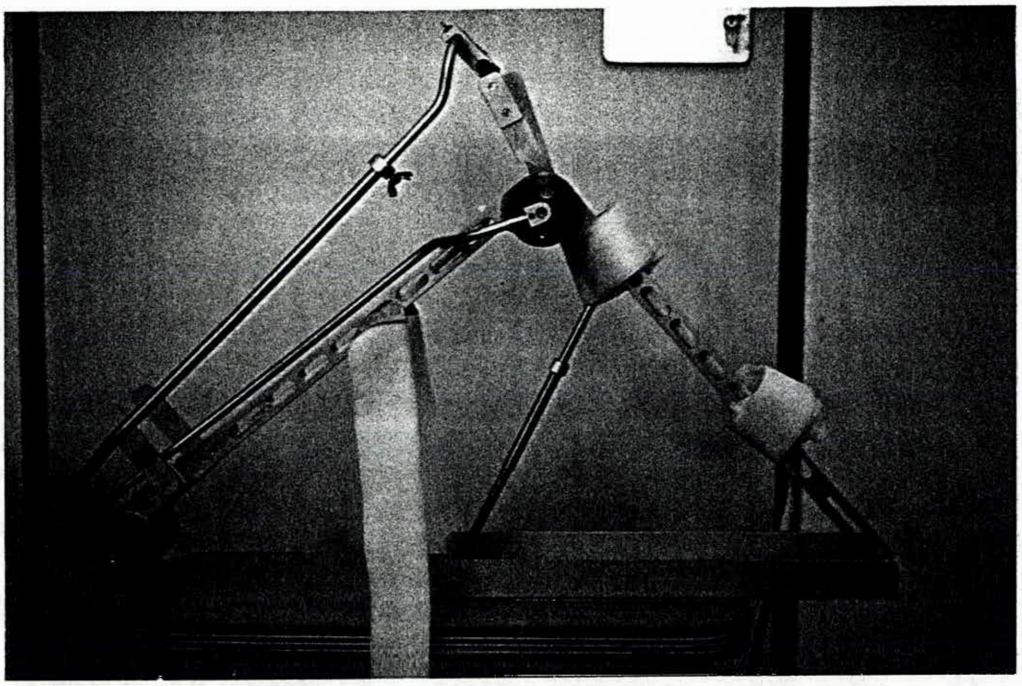


Fig.:6
registration of EMG,lower leg movement and impact of reflex stimulator

g.Innsbruck Neurological Investigation Scale
In order to enable a comparison of clinical neurological data a computerized investigation scale has been established. This neurological investigation scale is usees especially to demonstrate the course of neurological changes occuring during simulated microgravity in immersion.

3.3 Soviet part.

a. To fulfill the tasks of the cooperation it was nesessary to organize the possibilities for the performance of microgravity simulating experiments at the IBMP facilities and at the neurological clinic, Innsbruck. Thus the first step of joint project was the preparation and performance of "dry" immersion experiments at the IBMP, during which the soviet specialists demonstrated the technics of the experiment and posibilities of neurophysiological studies in simulated weightlessness.

b. The next step in this common project was to support the build up of specific library in Innsbruck concerning research literature of space neurophysiology.

c. Twentytwo volunteers have been investigated in the short term immersion experiments at the IBMP since 1988. The neurophysiological methods, used in these experiments have been developed previously at the IBMP to investigate the adaptation mechanisms at different levels of the motor control systems.

d.The following methods of investigations have been used by the soviet specialists in these experiments:

1. Gaze fixation reaction (GFR) with the registration of eye and head movements to the different visual targets in the horizontal plane. The procedure of this method was described previously (Kozlovskaya, 1981, Barmin,1990)in details.

2. The investigation of posture control using the method of stabilography. The displacement of the body in saggital and frontal axies and EMG activity of the antigravitational muscles (m.m. soleus and tibialis anterior) have been recorded and measured by this method of investigation. The procedure of investigation in details was described previously (Kozlovskaya, 1981; Kozlovskaya, 1988).

3. T- and H-reflexes were registrated from the triceps surae muscle. The investigation of eye-head coordination and measurements of T- and H-reflexes have been performed before, during and immediately after immersion. The stabilographic investigations have been performed only before and after immersion.

e. Four volunteers have been checked and prepared for the joint experiments with austrian specialists at the IBMP immersion laboratory using combined neurological and neurophysiological methods.

4. RESULTS

Common investigations focussing on neurological alterations and on changes of the head and eye movements, the latter measured by the MRS equipment, were performed in 8 volunteers.
Four volunteers were investigated at the laboratories of the IBMP Moscow at two times and 4 volunteers at the Innsbruck immersion laboratories.

A.

INVESTIGATIONS AT THE IBMP IMMERSION LABORATORY
DECEMBER 1989 AND APRIL 1990

Four male volunteers (24,26,27,42 a) have been placed for 72 hours into the horizontal water immersion basin. Detailed neurological investigations by two neurologists at the same time have been done before the experiment and 24, 48 and 72 hours thereafter. The experiment took place in December 1989 (volunteer M & S) and in April 1990 (volunteer F & B).

I. neurological investigations

The neurological examination, part of a detailed investigation program, had been done according to a special prepared check list. The Innsbruck Neurological Investigation Scale with a range from -4 to +4 had been worked out in order to enable a comparison, respectively a computerized documentation and analysis of neurological findings.

The neurological findings before the experiment as well as the outstanding changes occuring during(I) and after 72 hours water immersion (II) are presented in Tab. 1 to 4.

Tab.: 1 volunteer M., 27 years

I.

1. accentuation of reflexes left side
2. slight pyramidal signs left sided
3. deficiency of convergence

II.

1. increasingly interrupted eye movements and opsoclonus
2. increasing deficiency of convergence
3. decrease of masseter tonus and masseter reflex
4. decrease of muscle tonus upper / lower limbs
5. decrease of reflex amplitude left side accentuation
6. increasing deterioration of fine motor function right side accentuation
7. increasing dysesthesia at the distal parts of the limbs
8. occurence of cerebellar signs and symptoms
9. occurence of frontal lobe signs and symptoms
10.decrease of bathyesthesia

Tab.: 2 volunteer S.; 24 years

I.
NAD

II.

1. decrease of massseter tonus and masseter reflex
2. decrease of muscle tonus upper and lower limbs
3. decrease of reflex amplitude
4. gradual deterioration of fine motor function
5. occurence of cerebellar signs and symptoms
6. occurence of frontal lobe signs and symptoms

Tab.: 3 volunteer F., 26 years

I.

NAD

II.

1. increase of masseter tonus and masseter reflex
2. decrease of muscle tonus upper/lower limbs
3. decrease of reflex amplitude
4. gradual deteriorationn of fine motor function
5. occurence of cerebellar signs
6. occurence of frontal lobe signes

Tab.: 4 volunteer B., 42 years

I.

1. accentuation of reflexes left sided
2. positive pyramidal signs left sided
3. slight face weakness left sided
4. positive frontal lobe signs

II.

1. interrupted eye movements
2. increase of masseter tonus
3. decrease of muscle tonus in general
4. decrease of reflex amplitude left side accentuation
5. gradual deterioration of fine motor function left side accentuated
6. increase of frontal lobe signs
7. occurence of cerebellar signs

In summary all four volunteers showed a decrease of muscle tonus, reflex amplitude (Fig. 7) as wel as a gradual deterioration of fine motorfunctions and an occurence of cerebellar (Fig. 8) and frontal lobe signs (Fig. 9).

In two of the four volunteers neurological microsymptoms have been detected at the investigation before the experiment. These symptoms occured to be more pronounced after the experiment.

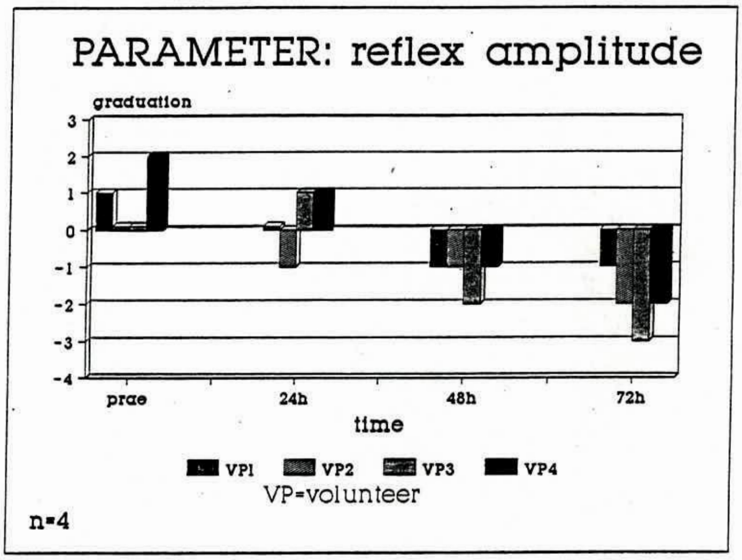


Fig.: 7 reflex amplitude decrease

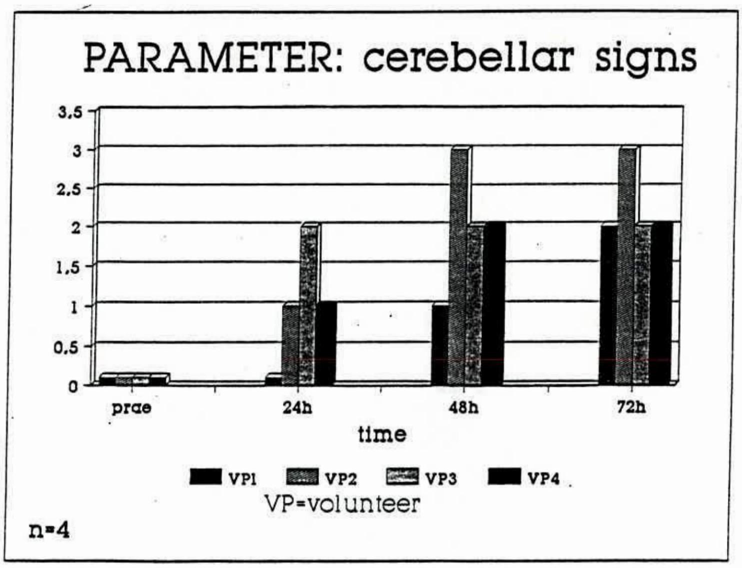


Fig.: 8 occurence of cerebellar signs

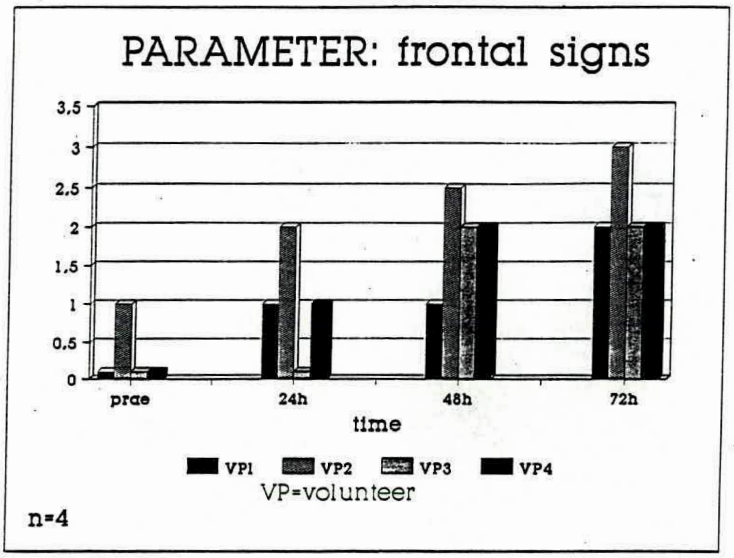


Fig.: 9 occurence of frontal lobe signs

II. investigation of altered movement pattern

1.1 the influence of proprioceptive receptors on the position of the forearm

1.2 the influence of proprioceptive neck receptors on head posture

This experiment in two volunteers (M & S) took place in December 1989. At this time a partly computerized equipment was used.

Fig.:10
picture of equipment used in this experiment

ad 1.1

The neutral position was defined as vertical position (90°).
The flexion and extension of the forearm was measured as shown in Fig.10

As the picture shows the upper arm has been fixed. The divergence has been measured in degrees (max. 45°). The aiming has been done first fife times under visual control thereafter fife times without. As vol. M. and S. were right handed the measurement has been done only on the right upper limb.

1.1.1 divergence in degrees of the neutral position of the forearm after alternating passive flexion and extension (Fig.: 11)

1.1.2 divergence in degrees of the neutral position of the forearm after isometric extension of the extended arm (Fig.: 12) alternately to the isometric flexion of the flexioned arm (3 kg during 5 sec.) see Fig.: 13

ad 1.2

axial head rotation

the neutral position of the head was defined as the volunteer had to fix a special marker (Fig.: 14)

1.2.1 divergence in degrees of the neutral position of the head after passive rotation to the right and to the left (Fig.: 15)

1.2.2 divergence in degrees of the neutral position of the head after isometric muscle contraction (head in neutral position) to the right and to the left (3 kg during 5 sec. see Fig.: 16)

1.2.3 neutral position of the head after isometric muscle contraction

a. head rotated to the left with isometric contraction to the right

b. head rotated to the right with isometric contraction to the left (Fig.: 17 and 18)

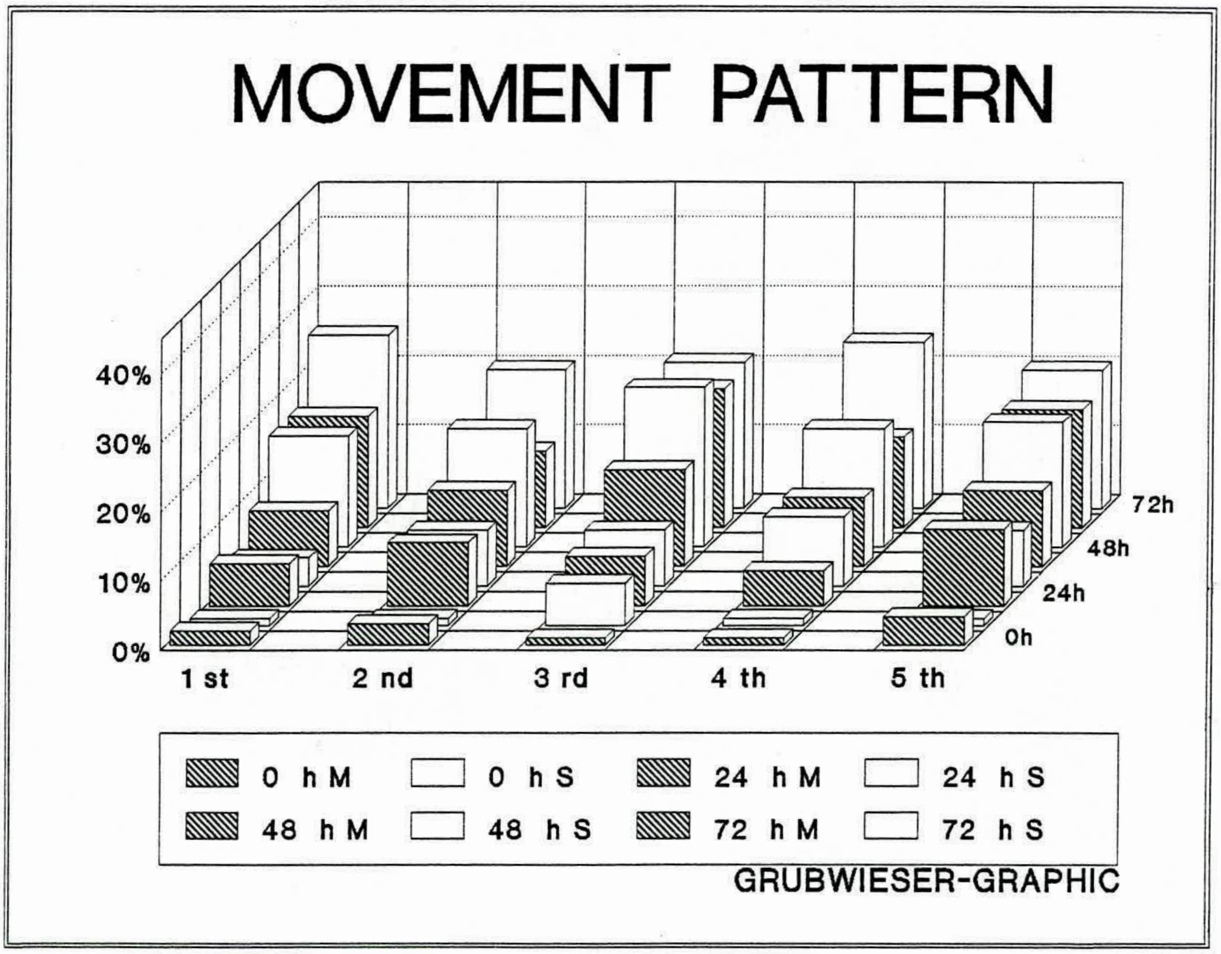


Fig.: 11
divergence in degrees (max. 45°) of the neutral position of the forearm after alternating passive flexion and extension

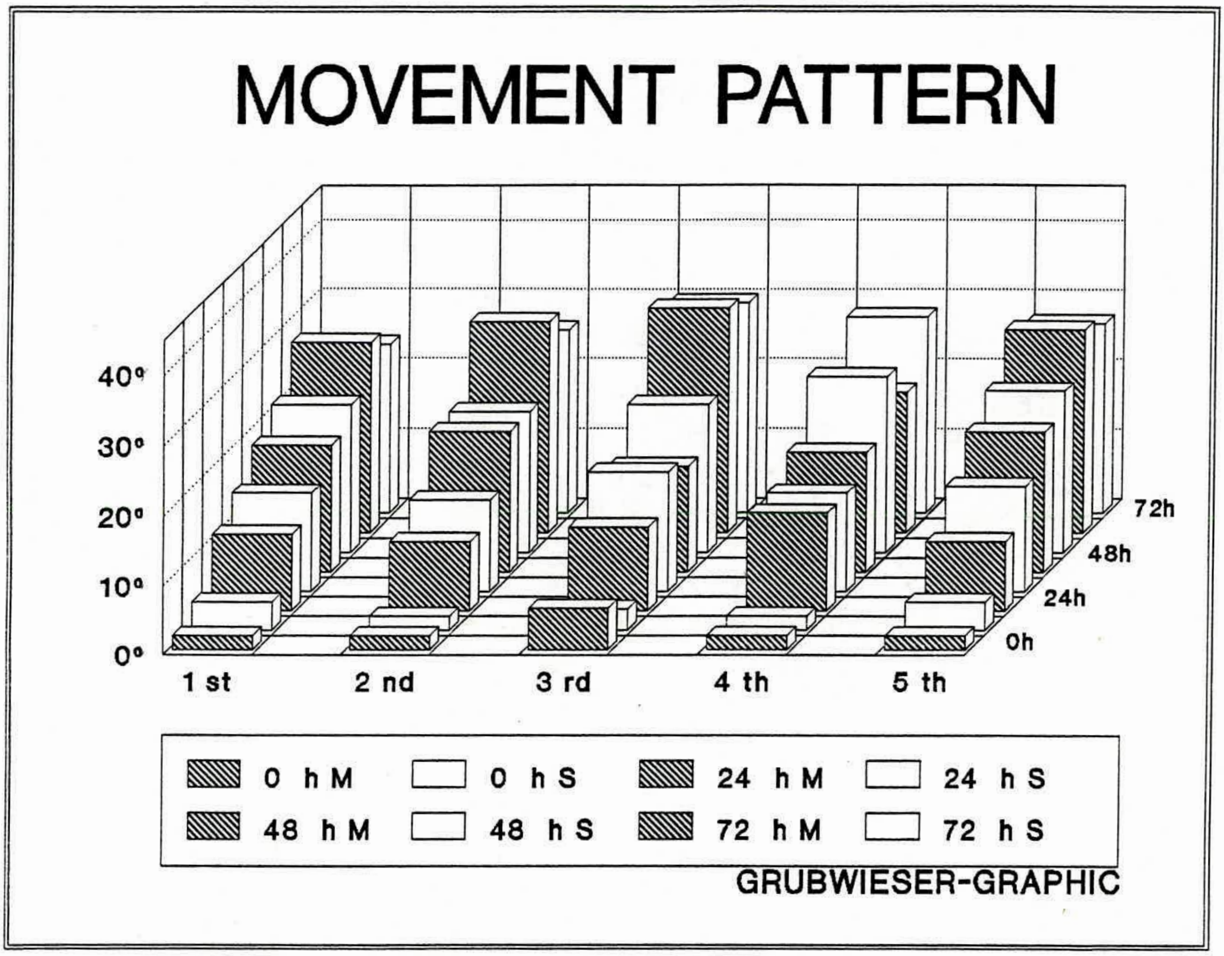


Fig.: 12
divergence in degrees (max. 45°) of the neutral position of the forearm after isometric extension of the extended arm

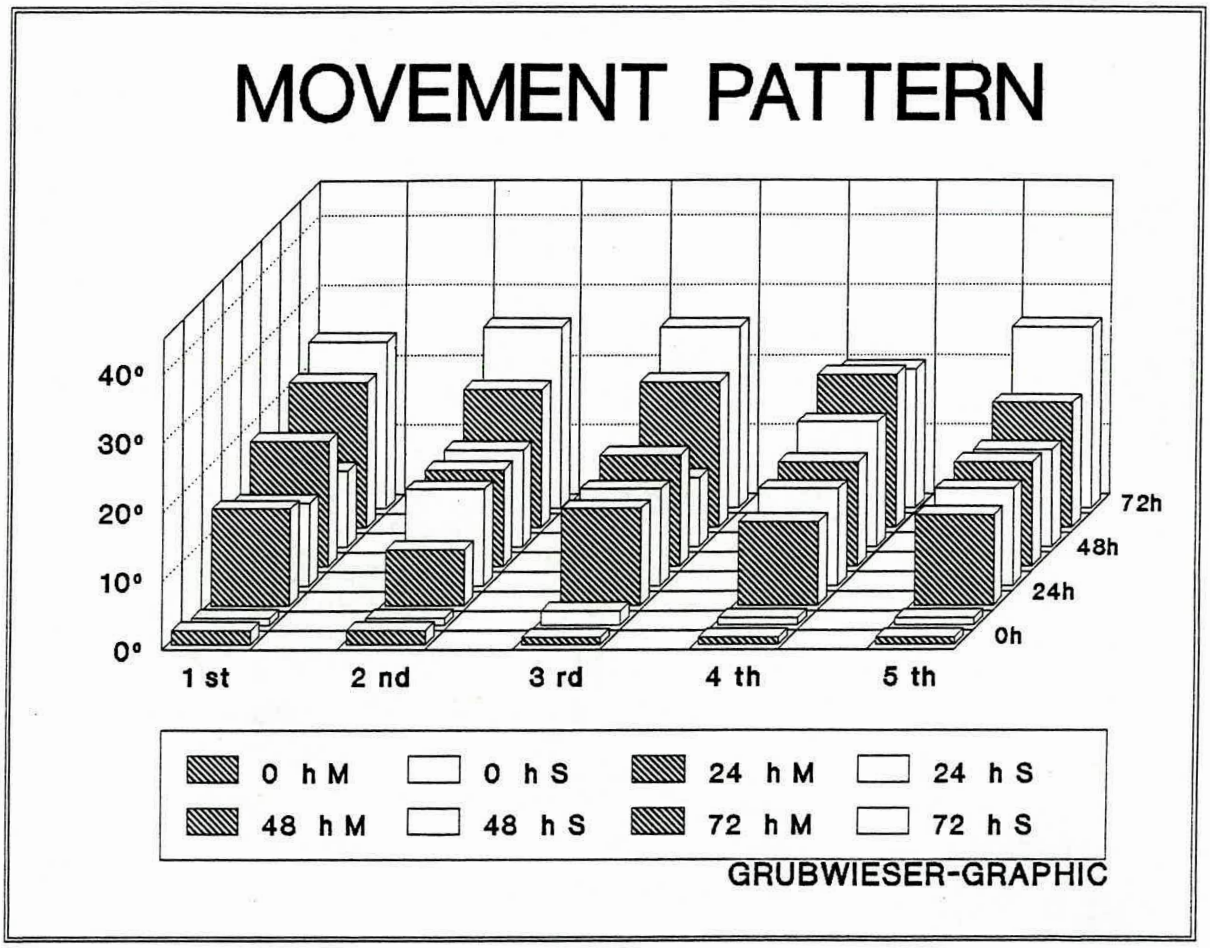


Fig.: 13

divergence in degrees (max.45°) of neutral position of the forearm after isometric flexion of the flexioned arm (3kg during 5 sec.)

Fig.: 14

picture of experiment 1.2

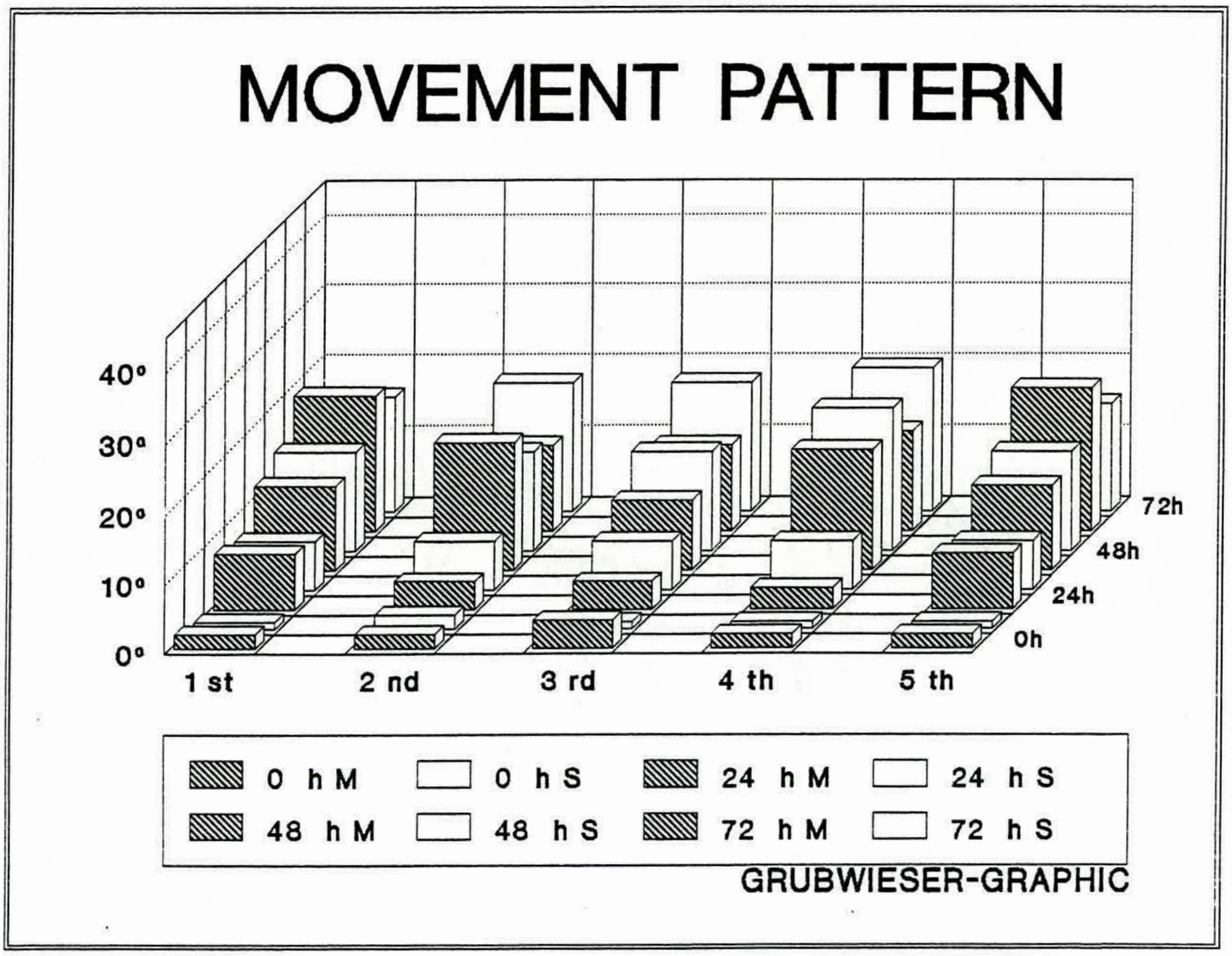


Fig.: 15

divergence in degrees (max.45°) of the neutral position of the head after passive rotation to the right and to the left

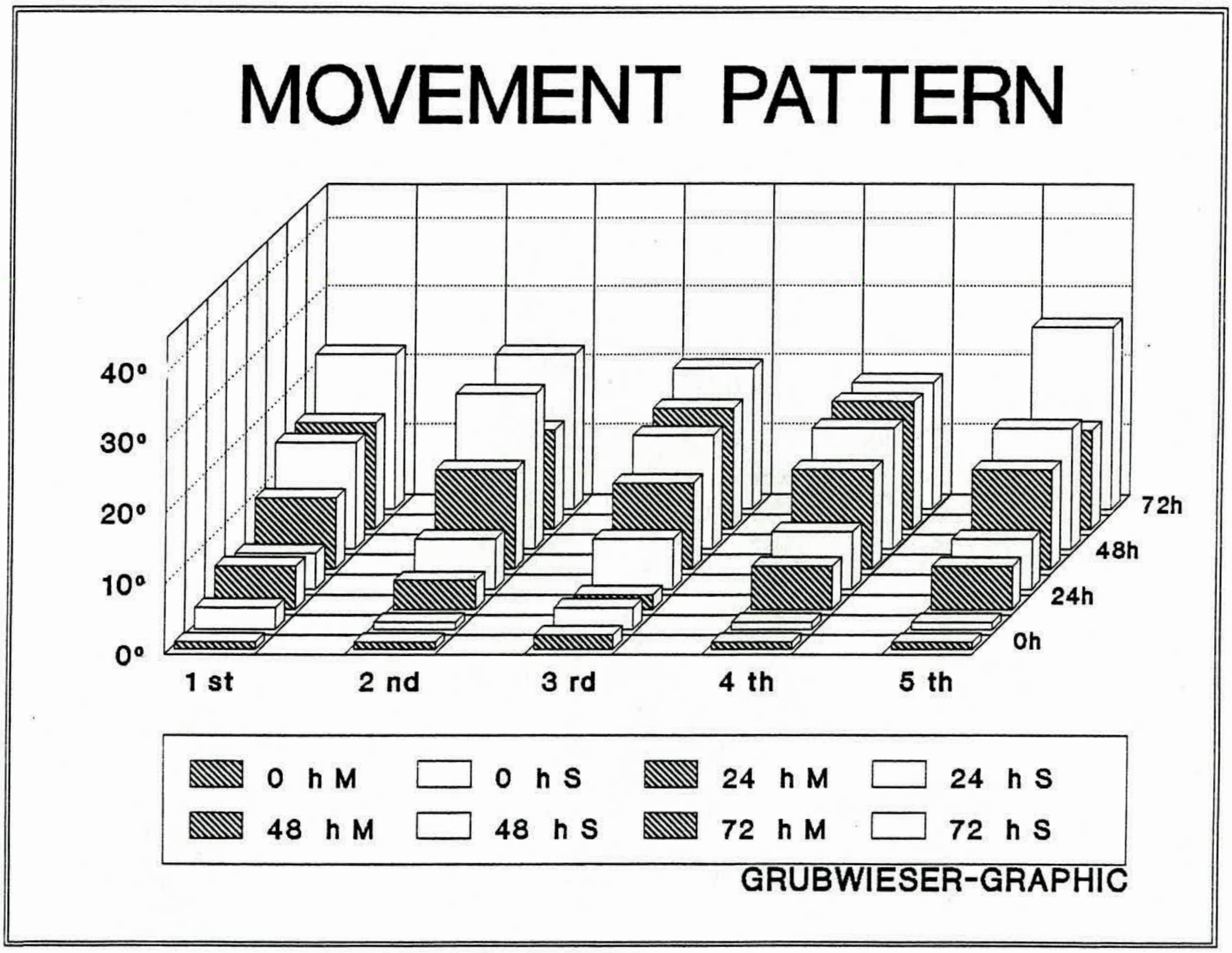


Fig.: 16

divergence in degrees (max.45°) of the neutral position of the head after isometric muscle contraction (head in neutral position) to the right and to the left (3 kg.during 5 sec.)

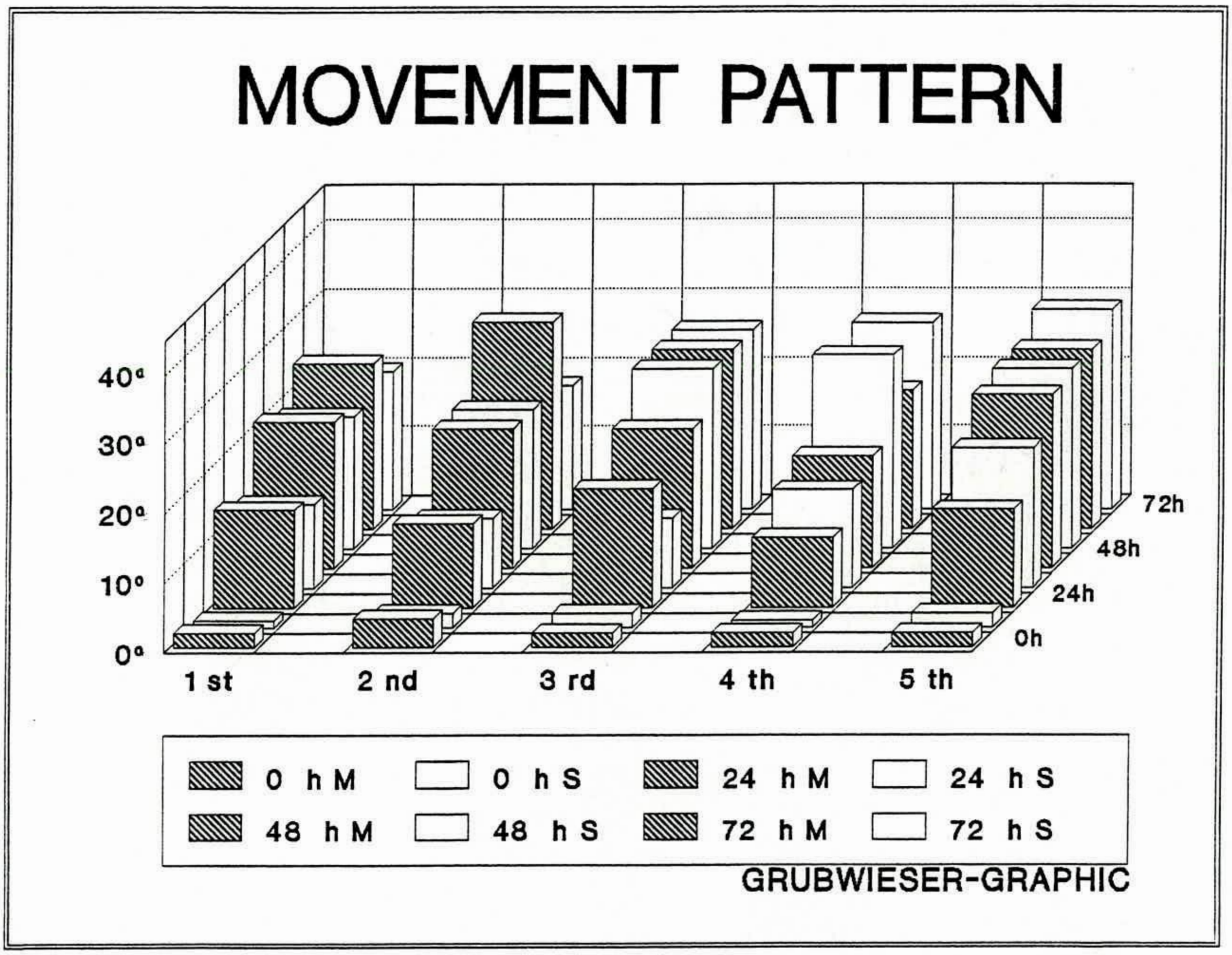


Fig.: 17

divergence in degrees (max.45°) of the neutral position of the head after isometric muscle contraction - head rotated to the left with isometric muscle contraction to the right

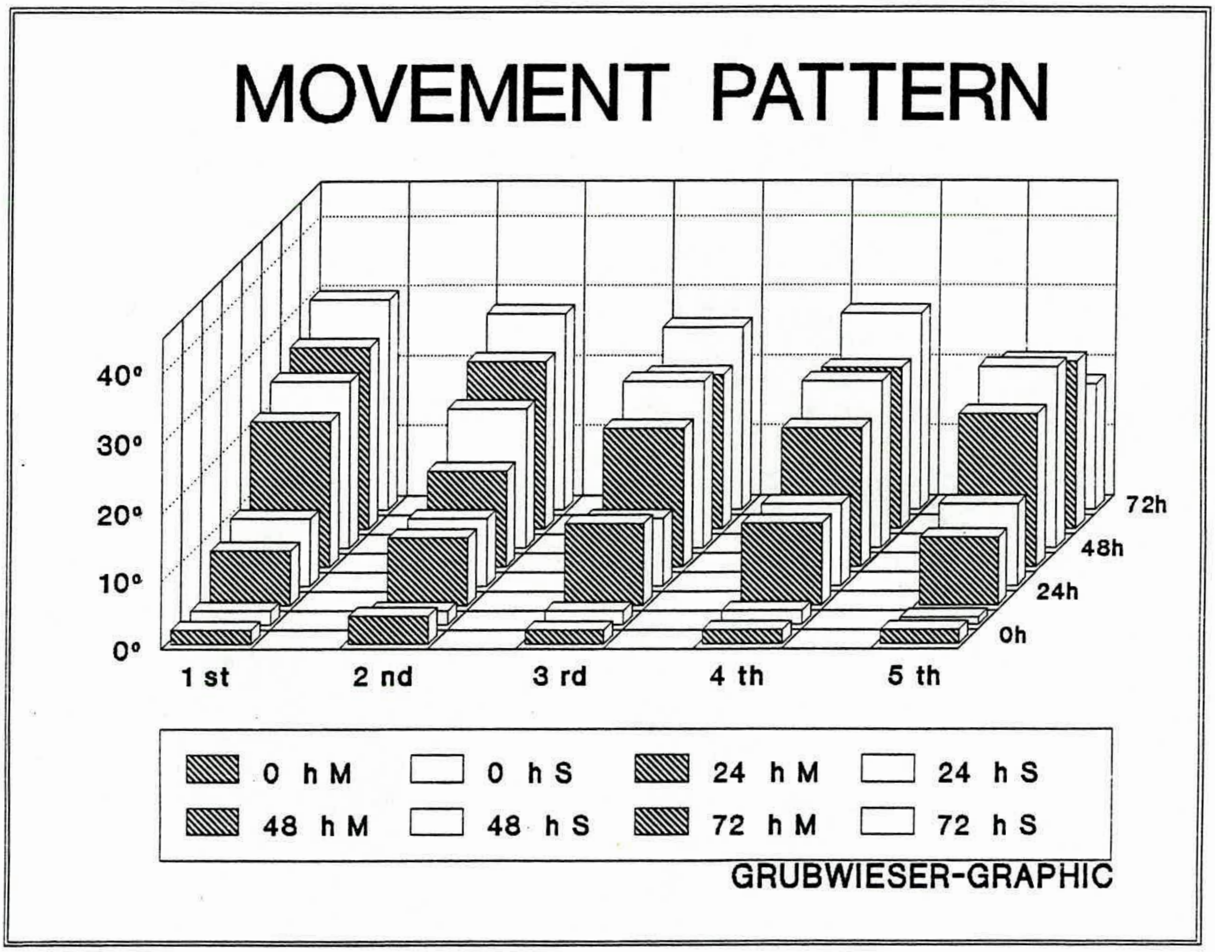


Fig.: 18

divergence in degrees (max.45°) of the neutral position of the head after isometric muscle contraction - head rotated to the right and isometric muscle contraction to the left

Second part of investigations in April 1990 (volunteer F & B).

In this experiment the investigation program has been focussing on neurological alterations caused by 72 hours of immersion - see part I of results, volunteer F. and B. - and on altered movement pattern due to altered proprioceptive inputs.

For this experiment the MRS complex has been used. Because of difficulties to use this equipment inside the immersion basin this examination has been performed pre and after immersion.

The steps of this investigation have been described above.

As we investigated two volunteers only some remarkable apects of our data obtained at this investigation will be presented.
After we have worked out the data of the 4 volunteers obtained during the investigations in November 1990, a statiscilly relevant trend can be documented.

remarkable changes pre and post immersion:

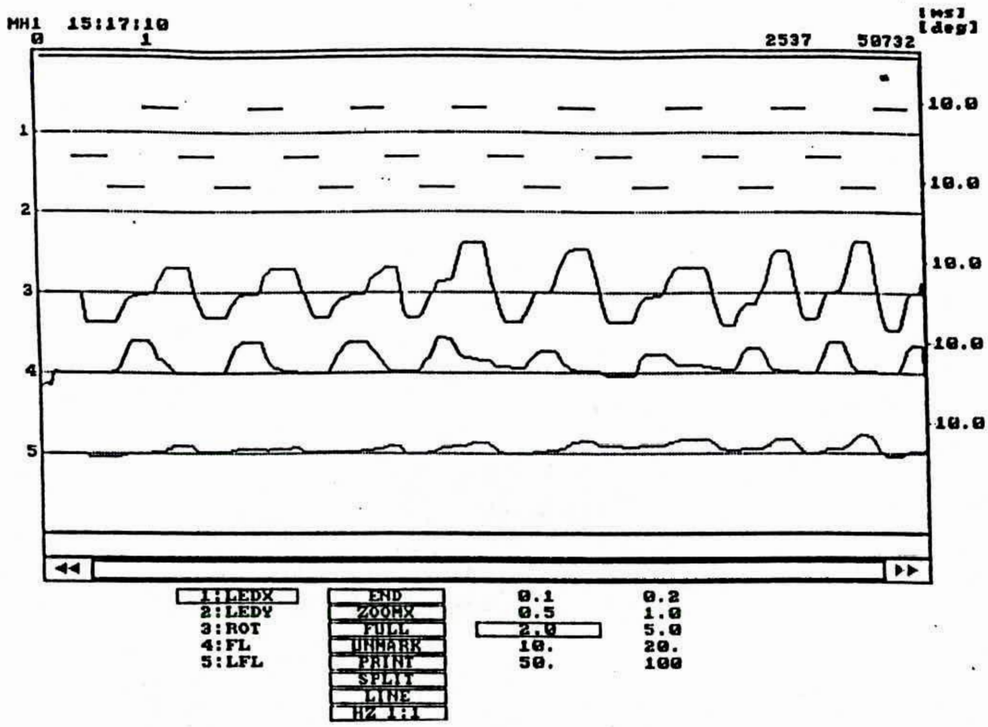
a. shift of the head movements in the vertical axis Fig.: 19

b. significant shift of the arm movements in the horizontal axis more to the left side but also in the vertikal axis - Fig.: 20

c. a decrease of errors by pointing at the LED target within 24 hours between day one and two of immersion, demonstrating an adaptation mechanism - Fig.: 21

d. A similar decrease of errors as mentioned above has been observed also after lateroflexion - Fig.: 22. The differences of error degree between pointing at the LED target position head straight and lateroflected is noticeable.

As mentioned above a statistically relevant statement can be made only afetr investigation of more than two volunteers. Thus a precise documentation of trends will be published after the work out of the Innsbruck data (November 1990).



LEGEND

Acoustic	acoustic signal horizontal
LEDX	visual signal horizontal
LEDY	visual signal vertikal
EOG HOR	eye movement horizontal
EOG VER	eye movement vertikal
ROT	head rotation
FL	head flexion
LFL	head sidebending (lateroflexion)
ROA	arm movement horizontal (rotation arm)
FLA	arm movement vertikal (flexion arm)

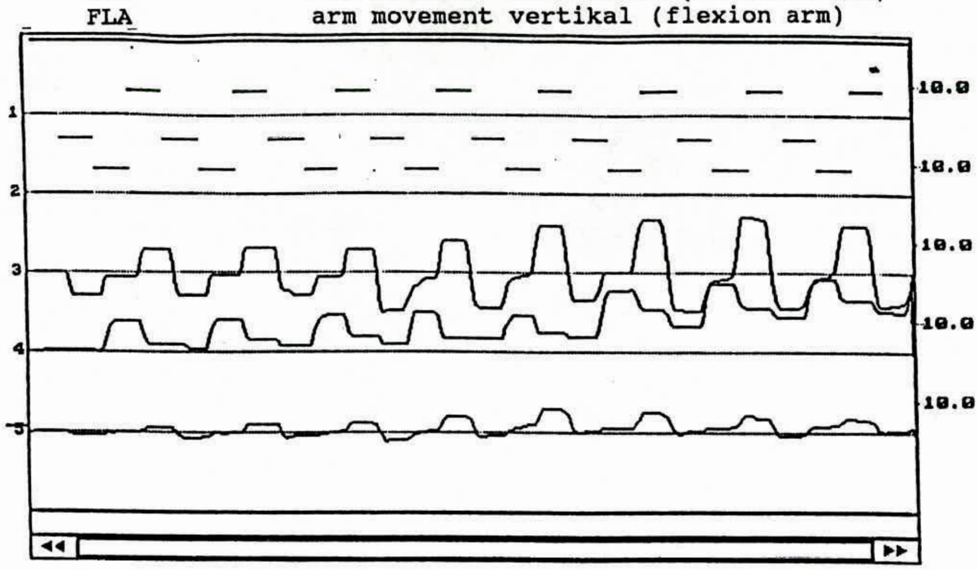
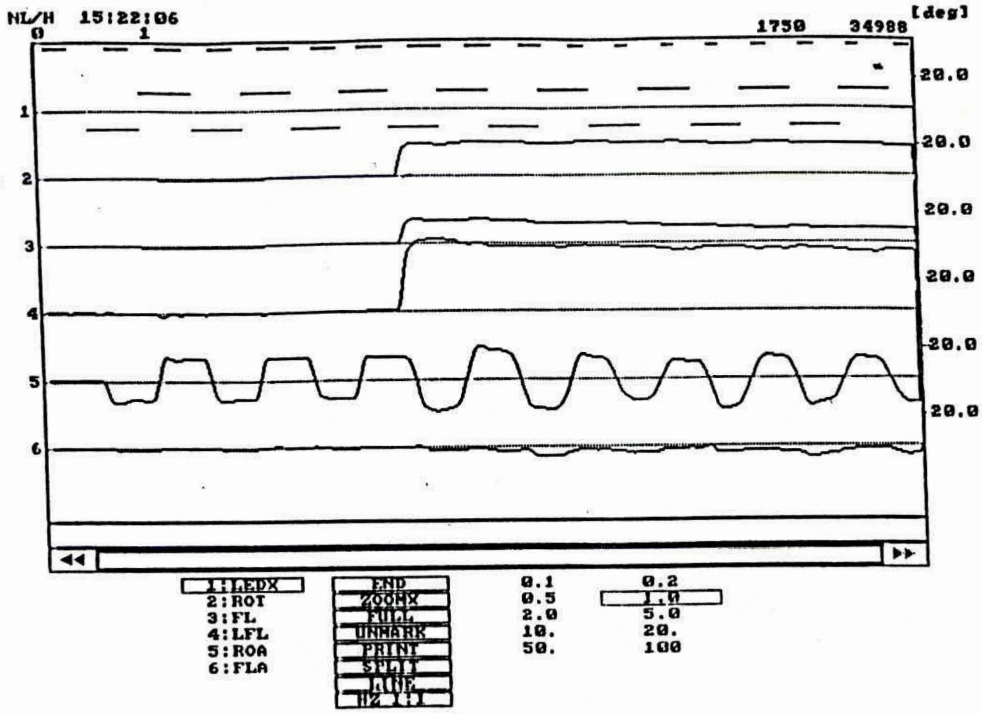


Fig.: 19 a and b

reproduceability of head movements without visual control

LEDs are illuminated in a triangle pattern, the volunteer has to fix by eyes each illuminated LED 3 times with open eyes and then repeats with closed eyes



LEGEND

Acoustic	acoustic signal horizontal
LEDX	visual signal horizontal
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EOG HOR	eye movement horizontal
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ROT	head rotation
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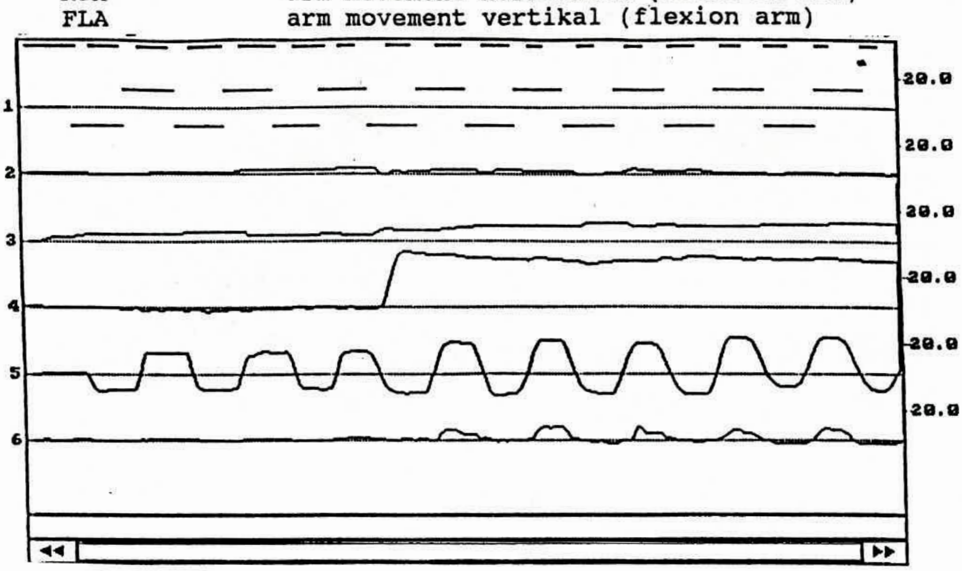

Fig.: 20 a and b.
influence of neck receptors and vestibular system on horizontal arm movements
the volunteer is aiming at illuminated LEDs 6 times with and ten times without visual control

NECK - REFLEX

head staight 1. and 2. day in immersion.

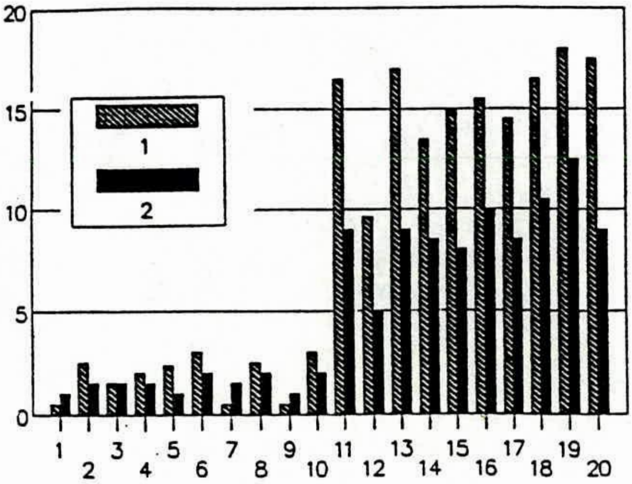

Fig.: 21

errors by aiming at LED target with open and closed eyes

an adaptation in water immersion with a decrease of errors within 24 hours between day 1 and 2 of immersion has been found

X axis - number of LED

Y axis - degree of deviation

head straight

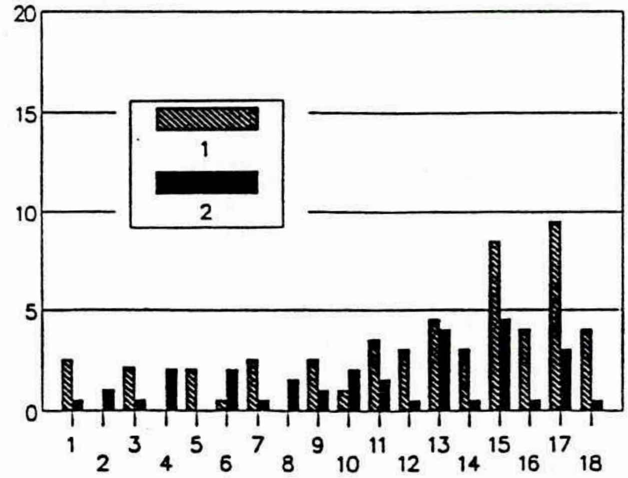

Fig.: 22
adaptation in water immersion : decrease of errors by aiming at the LED target, 1st and 2nd day of immersion
X axis number of LED
Y axis degree of deviation
head latero flected

B.

INVESTIGATIONS AT THE INNSBRUCK IMMERSION LABORATORY NOVEMBER 1990

Three female and one male volunteer participated in this third part of investigations. While 2 volunteers (L.K., 19 years of age and S.A., 25 years of age) stayed for 72 hours in the immersion basin the other (R.Sz.,24 years of age and Ö.Cs.,28 years of age) had to stay the same time in bed. To differentiate the influence of bed rest vs.immersion on expected alterations, the horizontal bed rest has been performed. The first 72 hours of the experiment started on November 20th.

After a recompensation time of 96 hours the two teams changed.

Staying for 6 hours in the immersion volunteer R.Sz. refused to participate because of increasing motion sickness like symptoms with vertigo and nausea but no vomiting.

To obtain reproduceable data in experiment V.b.and c. all 4 volunteers got a special and well defined food.

The following investiagtions took place:

I. clinical neurological investigations
pre,24h,48h and 72h of immersion

II. documentation of eye, head and upper limb movement pattern alterations to optic and acoustic stimuli

This experiment using the MRS equipment has been performed pre and after the immersion or bed rest as it was impossible to use the equipment inside the immersion basin because of a possible damage of the awning.

III. T-reflex measurement
pre and after immersion

IV. stabylographic investigations

V. biochemical investigations

V.a. orthostatic syndrome, adrenaline levels

V.b.3 MHT in blood sampls and urine
see suppl.4

V.c. Myosin, Myoglobin, Creatininphosphokinase (activity and quantity) free Tyrosine

I. clinical neurological investigations

1. volunteer L.K.; female, 19 y

1.1 neurological findings pre, during and post 72 hours of bed rest

		pre	24h	48h	post
saccadic eye movements		0.5	0.5	0.5	0.5
convergence R		0.5	0.5	0.5	0.5
facial nerve (central)		0.5	0.5	0.5	0.5
reflexes upper limbs	R	1.0	0.5	0.5	0.5
	L	1.5	1.5	0.5	0.5
reflexes lower limbs	R	1.0	1.0	1.0	1.0
	L	1.5	1.5	1.5	1.5
fine motor functions	R	0	0	0	0
	L	0	0	0.5	0.5
pyramidal signs	R	2.0	2.0	2.0	3.0
	L	3.0	3.0	3.0	3.0
cerebellar signs	R	1.0	/	/	1.0
	L	0	/	/	0
frontal signs		1.0	1.0	1.0	1.0

1.2 neurological findings pre,during and after 72 hours of immersion

saccadic eye movement		0.5	0.5	0.5	1.0
nystagm to	R	0.5	0.5	1.0	1.0
	L	0	0	0	0
facial nerve (central left)		0.5	0.5	0.5	0.5
reflexes upper limbs	R	1.0	0.5	0.5	0
	L	2.0	1.0	1.0	0.5
reflexes lower limbs	R	0.5	0.5	0.5	0
	L	1.0	1.0	1.5	1.0
fine motor functions	R	0.5	0.5	1.0	1.0
	L	1.0	1.0	1.5	2.0
muscle tonus	R	0	-0.5	-1.0	-1.5
	L	0	0	-0.5	-0.5
pyramidal signs	R	0.5	0.5	2.0	2.0
	L	0.5	1.0	2.0	3.0
cerebellar signs	R	0	/	/	1.0
	L	0	/	/	2.0
frontal signs		1.0	2.0	2.0	3.0
hypesthesia u.l.	R	0	0	0	0.5
	L	0	0	0.5	0.5
l.l.	R	0	0	0.5	1.0
	L	0	0	0.5	1.0

comment:

neurological signs and symptoms of right hemispherical lesion probably due to birth complications (asphyxia)

a decrease of the reflex amplitude could be found also during bed rest but not to this degree as seen after immersion

slight occurence of cerebellar signs during and post bed rest but have been more significant during and post immersion

frontal signs could be detected even at the pre examination and did increase during and post immersion

the decrease of the muscle tonus seemed to be more significant post immersion

occurence of hypesthesia in upper and lower limbs post immersion

2. volunteer S.A. (female, 25 years)

2.1 neurological findings pre, during and after 72 hours of bed rest

			pre	24h	48h	72h
nystagm to the		R	0	0	1.0	1.0
		L	0.5	0.5	0.5	0.5
fine motor functions	u.l.	R	1.0	1.0	1.0	1.0
		L	0.5	0.5	0.5	0.5
	l.l.	R	0	0	0	0
		L	0	0	0.5	0.5
reflexes	u.l.	R	0.5	0.5	0.5	0.5
		L	1.0	1.0	1.0	1.5
	l.l..	R	1.0	0.5	0.5	0.5
		L	1.0	1.0	1.0	1.0
muscle tonus	u.l.	R	0	0	0	-0.5
		L	0	0	0	0
	l.l.	R	0	0	0	0
		L	0	0	0	0
frontal signs			0.5	0.5	0.5	0.5

2.2 neurological findings pre, during and after 72 hours of immersion

saccadic eye movements			0	0	0.5	1.5
nystagm to the		R	0	0	0.5	1.0
		L	1.0	1.0	1.5	2.0
opsoclonus horizontal			0	0	0.5	1.0
fine motor functions	u.l.	R	0	0.5	1.0	1.5
		L	0	0.5	0.5	1.0
	l.l.	R	0	0	0.5	0.5
		L	0.5	1.0	1.0	1.5
reflexes	u.l.	R	0	0	0.5	1.0
		L	0	0.5	1.5	2.0
	l.l.	R	2.0	2.0	1.5	0.5
		L	2.5	2.0	1.0	1.0
muscle tonus	u.l.	R	0	0	-0.5	-1.0
		L	0	0	0	-0.5
	l.l.	R	0	0	-0.5	-1.0
		L	0	0	0	0
pyramidal signs		R	0	0	0	0
		L	0	0	0.5	0.5
cerebellar signs			0.5	/	/	1.5
			pre	24h	48h	72h
frontal signs			0	0.5	1.0	1.5

coment:

nystagm to the left has been found even in the pre examination and increased in bed rest after 48 hours
in immersion this nystagm seemed to be more pronounced and increased after 72 hours of immersion

in immersion saccadic eye movements and also an opsoclonus occured after 48 hours

the fine motor functions showed a slight deterioration in bed rest more pronounced after immersion

the reflex amplitude decreased in both the bed rest and the immersion slightly more pronounced after immersion

the muscle tonus decreased significantly after immersion

pyramidal signs not to be found at the pre examination and post bed rest could be seen on the left side after immersion

cerebellar signs did increase after immersion

preexisting frontal signs increased after immersion

3. volunteer R.Sz. (female, 24 years)

3.1 neurological findings pre,during and after 72 hours of bed rest

			pre	24h	48h	72h
nystagm to the		R	0.5	0.5	0.5	1.0
		L	0	0	0	0
fine motor functions	u.l.	R	1.0	1.5	1.5	1.5
		L	0.5	0.5	0.5	0.5
	l.l.	R	0.5	0.5	1.0	1.0
		L	0	0	0	0
reflexes	u.l.	R	1.0	0.5	0.5	0.5
		L	0.5	0.5	0	0
	l.l.	R	1.0	1.0	0.5	0.5
		L	0.5	0.5	0.5	0.5

3.2 neurological findings pre,during and after 72 hours of immersion

after 6 hours of stay in immersion the volunteer refused to participate

4. volunteer Ö.Cs. (male, 28 years)

4.1 neurological findings pre, during and after 72 hours of bed rest

N A D

4.2 neurological findings pre,during and after 72 hours of immersion

			pre	24h	48h	72h
nystagm to the		R	0	0.5	1.0	1.5
		L	0	1.0	1.5	2.0
reflexes	u.l.	R	1.0	2.0	0.5	0.5
		L	1.0	2.0	1.0	1.0
	l.l.	R	1.5	1.5	1.0	1.0
		L	1.5	2.5	2.0	2.0
muscle tonus		R	0	0	0	-0.5
		L	0	0.5	0.5	0.5
corneal reflex		R	0	0	0	0
		L	0	0.5	0.5	1.0
cerebellar signs		R	0	0	0	0
		L	0	0	0.5	1.0
frontal signs			0	0.5	1.0	1.0

comment:

there have been no neurological findings neighter at the pre examination nor after 72 hours of bed rest

during and after immersion cerebellar and frontal signs occured

an increase of reflexes after 24 hours of immersion with consecutive decrease but remaining reflex accentuation on the left side revealed

the muscle tonus decreased slightly on the right side whereas increased similar to the reflexes on the left side

concordant to the decrease of the corneal reflex on the left side a nystagm more to the left side occured

INVESTIGATION II,III,IV and V

These experiments have not been worked out till the finishing of this final report and will be presented separately.

5.CONCLUSIONS.

5.1. The comparison of the data, obtained of 72 hours stay in immersion revealed the close similarity of neurophysiological and neurological effects of "dry" water immersion and short term real space flights. This method seems to be adequate for the investigations of CNS disturbances during the acute period of microgravity influences already proved by other authors,as already mentioned above.

5.2 The analysis of our data - as finished till November 1990-let us suggest an altered feed back activity responsible for atactic disorders (pseudotabic symptoms) , decrease in support reactions, and reduction of the strength of gravitational muscles etc.

5.3. It seems to be evident that the most important factor which led to these disturbances during the short term exposure to simulated microgravity is the decreasing of proprioceptive and support afferentations.

5.4 In the absence of support loads the tonus of the antigravitational muscles decrease (Graveline 1961; Mitarai 1978). This decrease of muscle tonus was found also in all the volunteers investigated by clinical neurological methods. Muscle tonus and reflex amplitude decrease are well known signs and symptoms of cerebellar dysfunction (concerning clinical neurological terms). In all the 7 volunteers not only the mentioned changes in muscle tonus and reflex amplitude have been found but also signs of ataxia, rebound phenomenon and in 4 cases an increasing nystagmus. All these clinically observed symptoms

could be cerebellar signs and symptoms.
A possible explanation and working hypothesis respectively is a deafferentiation.
Previous studies, however, have shown that the decrease of muscle tonus is the factor that initiates changes in different parts of the motor system, videlicet muscle afferents, motoneuron entities etc. whose activity is also determined by the motoneuron activity.
The occurence of frontal lobe signs which will increase during stay in immersion can only be registrated but not explained.
Hypothetically deafferentiation could be one of it's triggers.

5.5 Beside this compensated microlesions of the CNS may decompensate in simulated microgravity. Neurological deficits diagnosed before the 72 hours of water immersion became more prominent even after 24 hours of immersion.

5.6. The results of the joint experiments showed the necessity of combination the neurophysiological and neurological approaches in the investigation of CNS disturbances under microgravity conditions.

5.7. As a technical result of the cooperation the "dry" immersion model laboratory was established in Innsbruck. A special equipment (MONIMIR complex) for the investigation of the senso-motor integration was developed basing on the equipment developed and used in the past as well as basing on the experiences of the immersion model investigations.