The period of the experiment was one month: the number of days required for pre-compression, compression, pressure holding, decompression, and post-compression were 6, 1, 7, 11, and 5 days, respectively. The compression rate was set at a slow rate of 25m/hr. The partial pressure of oxygen gas at pressure holding was 0.3ATA. The subjects were four males (28 to 33 years), of whom two were scientists and two were professional divers. MV and EEG were measured with MV pickup (MT-3T) and disk type electrode, in the supine position and with the eyes closed. The fast Fourier transform of the data during every ten second epoch was measured from a signal processor ATAC-450 and the square root of power spectrum was obtained in the frequency range from 3 to 30 Hz. The maximum peak frequency and the amplitude at the maximum peak frequency were evaluated from the power spectrum. The mean values of the peak frequency and of the amplitude for each subject in pre-compression (i.e., 1ATA) days were used as respective control values (i.e., 100%). The mean values for each of the other atmospheric conditions for each subject were represented as a percentage of the baseline control value.

The amplitude of MV increased after compression compared with the value at pre-compression, and this observation was emphasized in the eyelid MV post-compression (i.e., 1ATA), whereas the peak frequency of MV did not change significantly throughout the experiment. A remarkable hyperbaric effect was observed, however, in the EEG peak frequency. The peak frequency of the power spectrum was lowered during each phase of compression, pressure holding, and decompression respectively. As the high pressure nervous syndrome symptoms was not overtly recognized here, especially as might have been expected during compression, MV could not be an indicator of symptoms of HPNS. The MV amplitude of the eyelid, whose muscles are composed in greater part of fast twitch fibers, increased still more post-compression. Therefore, the influence of high pressure on skeletal muscle must be considered as a source of the observation, particularly the ballistocardiogram component of the MV. The EEG denoted a lowering in the level of consciousness during pressure holding, and is especially noteworthy for us as relevant to the safe operation of humans in a hyperbaric environment.

29 Physiological reactions of the Rhesus monkey under high density gas hyperbaric environment (51 Bar, $He\text{-}N_2\text{-}O_2$, p=27g/l. BTPS)

K. Seki, Y. Taya, M. Nakano, Y. Mizushima, F. Shidara, and *H. Nakayama*[1]
Laboratory of Hyperbaric Physiology, Japan MarineScience and Technology Center (JAMSTEC), Natsushima-cho, Yokosuka-shi [1]Department of Hygiene, Tottori University, School of Medicine, Nishimachi, Yonago-shi, Japan

In 1981, Seki et. al. succeeded in bringing back cats alive to the surface after having exposed them for 72 hours to the high density $He\text{-}N_2\text{-}O_2$ environment of 27 g/l BTPS which is equivalent to the depth of 500 m. In 1981 and 1983, within the framework of Franco-Japanese cooperation on oceanic development, Seki et. al. carried out further experiments at the Laboratory of hyperbaric physiology of CNRS - GIS in France to see the effects on cats of their exposure to the hyperbaric high density gas environment, and succeeded in making them survive in the environment of 67 g/l BTPS which is equivalent to the depth of 1200m. The results thus obtained turned out to be different from those of our past experiments.

The experiment at 51 bar with $He\text{-}N_2\text{-}O_2$ was conducted under the following conditions: the ratio of He and N_2 was 3:2; PO_2 = 0.21 bar; ambient temperature at $34^oC \pm 1^oC$. On the first day of compression, due to the effects of N_2 narcosis, the behaviour of the cats was considerably restrained, but in time, their behavior became normal. The improvement of this ambient pressure diving method, which I tentatively named High Density Gas Hyperbaric Enviroment Diving Method will be rewarded with the following results: alleviation of high pressure nervous syndrome (HPNS); economy helium gas; the possibility of diving beyond the depths of 2,000m.

The aim of the present experiment was to obtain more detailed results than the ones already obtained from the experiments with cats. For that purpose, rhesus monkeys were used because their physiology is similar to man's.

The 4 male rhesus monkeys used in the experiments, weighed between 5.6 kg and 8.6 kg and were presumed to be 4 - 6 years old. One month prior to each experiment, the selected monkeys were put under ketamine hydrochloride anesthesia and electrodes and sensors for the recording of electroencephalogram, electroculogram, electromyogram, electrocardiogram and brain temperature were implanted. During the experiment, various physiological information was recorded 24 hours a day without interruption.

The physical conditions of the experiments are as follows: after 26 hours of prior observation in the atmospheric pressure environment of air, from 1 bar to 31 bars compression was made with He introduction, and from 31 bars to 51 bars.

Decompression was effected in 66 hours and 45 minutes for GENIUS-V,69 hours 15 minutes for GENIUS-II and 74 hours 47 minutes for GENIUS-III. During decompression, P02 value was kept at 0.8 bar. However, in the case of GENIUS-V, from 51 bars to 31 bars decompression was effected with P02=0.21 bar, and after 31 bars was reached, P02 value was brough up to 0.8 bar.

The four monkeys successfully survived the exposure to high density gas hyperbaric environment of the experiments. By the visual observation, it was witnessed that the behavior performance of all the monkeys decreased extremely on the first day at 51 bars, but from on second day their behavior performance began to return to normal, and behaviors witnessed previously at atmospheric pressure were resumed. During the duration of the experiments, all the monkeys drank water, ate food, defecated and urinated everyday.

Recording by the polysomnography of heart frequency during the sleep and awake stages shows that at 51 bars tachycardia occured more frequently than at 1 bar in normal air environment. The respiratory frequency showed the same tendancy with signficant increase at 51 bars. As to the narcosis effects incuded by the partial pressure of N2 at PN2=20 bars, the monkeys showed less effects than the cats. Concerning sleep stages, all the monkeys registered SWS and PS. As to the change of weight before and after each experiment, 5 cases out of 6 registered decrease of 4 ~11%, and only one registered increase of 6% (GENIUS-V). During decompression, one monkey showed signs of decompression disorders at the depth of 5m, but after recompression treatment, he was brought back to the surface safely.

In the present series of experiments, all the 4 resus monkeys lived at least 2 days and the 2 monkeys 4 days in the high density gas hyperbaric environment of 51 bars, He-N2-02 environment and p=27g/l BTPS. Maintaining the homeostasis of their bodies, they endured the very sever decompression stress resulting from the transition from hyperbaric environment to atmospheric pressure environment, and came back to the surfae succeeded in keeping alive monkeys for 4 days in the high density gas hyperbaric environment and in bringing them back to the atmospheric pressure environment.