tions were four and nine hours after the injuries, and their conscious disturbances continued more than seventeen days. Their cerebral atrophy was over a large area. One of them was greater in the injury than the contrary side and the other was greater in the contrary side. Third group: The cerebral injury by Conre-coup was found in four cases of this group. Two cases of them were light cerebral atrophy. Their conscious disturbances were within thirty seconds. The other two cases were diffuse cerebral atrophy in both sides. Their conscious disturbances were more than seven days. The latter case recived the operation after more than three months after the injury. The cerebral atrophy of one of this group was only in the side which incurred a depressed fracture. Their fractured parts intruded into cerebral substances. Fourth group: In the three cases of head injury, one by machine and two by forceps, high cerebral atrophy was found in the injured parts. The other parts, atrophy was light. One factor to consider is that conscious disturbances continued about ten to twenty minutes immediately after delivery in the cases of the forceps injury. This made their cerebral atrophy worse.

Conclusion: 1. Diffuse cerebral atrophy was widespread in both sides in the cases where conscious disturbances continued for a long time. 2. Cerebral atrophy was light in cases where conscious disturbances continued six days or less. 3. There were four cases which received their operations after more than four hours. These were the two cases of subdural hematoma (4 and 9 hours) and two cases of depressed fracture (3 and 4 months). Their conscious disturbances continued for a long period and their cerebral atrophy was widespread.

93. Research for Boxing

KAZUO AOYAMA

Nippon College of Health and Physical Education
Department of Exercise Physiology
Tokyo Labour Accident Hospital,
Department of Neurosurgery

The distinctive characteristics of head injury occurring in the course of boxing cannot be considered an emergency head injury but a mild closed head injury. This was discovered in the clinical research conducted on experimental animals over a period of several years. The mechanism of head injury does not apply to sports injury as the irreversible disturbance occurs through accumulation of mild closed repeated injury. Therefore head injury incurred through boxing is not an exception. Over a considerable length of time a research was conducted to determine the effect of recurring external force applied upon oryctolagus cuniculus domesticus (3-3.5 kg.) The strength of the external force and the glove used in this experiment was 1/20 of those used in the case of man. The external force was administered at random by means of a rubber ball attached to a metal rod. The reason for not
applying a designated force at a designated spot was because the experiment was a model experiment on boxing as it is actually been practiced. No restriction was placed on non-experimental animals. The animals to be used for the experiments were supported from behind so as to retain a standing position but otherwise they were free to move all parts of the body. The external force was applied in accordance with the rules of amateur boxing:— 3 minutes for the first round and after an interval of 1 minute the second round of force was applied. At no time was more than three rounds applied in one day. The external force applied during one round in 3 minutes was measured by semiconductor transducer placed on the skull of the subject showed 3.2 kg to 12.8 kg by in nitro and 2–5 gramms in nino. For experimental purpose the external force was considered as punch 1, 2, 3, 4. In each of these external force was applied at random ten times showing the total volume of the random external force applied during 3 minutes. As has been previously reported the slow down tendency observed from the frequency of scalp leads EEG was more remarkable when one round a day was applied every day over a period of 3 weeks than when 2 rounds were applied on every other day or 3 rounds applied at intervals of two days.

It was decided at this point to make a follow up study the results of over 6 weeks after an external force was applied over three consecutive weeks. Another follow study was made after three weeks of application of external force A long term follow up was extending over three years was conducted to determine the effects of consecutive force applied periodically. In the EEG follow up a recording was conducted on scalp lead by frontal and left and right monopolar lead. A recording was conducted on the frontal and central auto correlation and cross correlation. A recording of photo evoked potential was made on single stimulation conducted 40 time at random averaging on line. An estimation of biological changes occurring on body weight, urine volume body temperature and also appetite resulting from consecutive application of external force was recorded. A study was also made on the effects of the rapid reduction of weight and of the effects produced by the use of head protector.

The following is the summary of the neurosurgical points.

1) The slow down of EEG occurs after the application of consecutive external force and it progresses at each repetition. Recovery to the pre-experimental base line was not observed.
2) The slow component moved to the frontal region where the external force was centered.
3) The changes in the response of PEP appeared corresponding the time of the appearance of EEG slow down.
4) The natural increase in body weight was inhibited by the appreciation of external force.
5) The plastic head protector protects the soft tissues but it will not fundamentally protect the EEG slow down.
6) The slow down is remarkable when force is applied during the rapid reduction of weight.