Past and present of the Department of Neurophysiology in the Nencki Institute

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The Department of Neurophysiology was founded in the Nencki Institute in 1946. At that time the Institute was located in Łódź, since Warsaw had been destroyed during the war. The founders of the Department were Jerzy Konorski and Liliana Lubińska, the pre-war Institute’s workers. Konorski, the head of the Department, was a pioneer in investigations on instrumental conditioning. Within a few years he was joined by a group of about 15, mostly very young collaborators: a second generation of the Department’s workers. The first Konorski’s associates were: Zofia Afelt, Stefan Brutkowski, Elżbieta Fonberg, Włodzimierz Kozak, Wacława Ławicka, Irena Łukaszewska, Irena Stępień, Genowefa Szwajkowska (a pre-war Institute’s worker), Wanda Wyrwicka and Andrzej Zbrożyna. Their research was mainly devoted to various aspects of conditioning in dogs. This fitted the name of the Department since according to Pavlovian tradition, the conditioned-reflex investigations represent a part of physiological research.

In the middle fifties the Institute moved back to Warsaw, to a new, large building. About the same time the iron curtain was cracked in Poland and our west frontier became more open. Simultaneously the east frontier also became easier to cross. We began traveling frequently and many foreign scientists visited us. In consequence, the Department gradually lost its monolithic, conditioned-reflex profile, reacting rapidly to new tendencies in the international neuroscience. Visual, motor, psychophysiological and developmental investigations were introduced. In addition, the ethological group and later on the Laboratory of Neurochemistry (headed by Stella Niemierko, a pre-war Institute’s worker) joined us from other departments of the Institute.

In the early seventies Polish authorities offered more money for science and for the second time after the war many new positions became available in the Institute. Konorski’s pupils were joined by about 20 young researchers: a third generation of workers appeared in the Department. Some of them (Anna Grabowska, Małgorzata Kossut, Andrzej Wróbel, Jolanta Zagrodzka) are at present the heads of laboratories in the Department.

In 1973 Jerzy Konorski died and I succeeded him as the head of the Department. It was rather difficult to succeed a great leader and to direct the Department which was rapidly changing. However, I was fortunate to receive the help of several colleagues. I especially owe much to Irena Stępień and later to Jolanta Zagrodzka. I have also received important encouragement from two distinguished foreign colleagues, Jerzy Rose and Eliot Stellar.

Although large, the Department has remained well integrated. Our common roots are certainly one

* Prof. B. Żernicki has led the Department of Neurophysiology for almost thirty years (1973-2001). His contribution to the scientific development of the Department was memorized after his death (2002) in vol. 62, issue 2 of Acta Neurobiologicae Experimentalis.
of the important reasons of integration. The Department’s Wednesday seminars are excellent forum for
discussion of our results. Last but not least we help each other in many respects. For example, Anna Kosmal is
always ready to help in neuroanatomy and Kazimierz Zielinski in statistics.

We are fortunate that our Department is a part of the Nencki Institute. First, the development of
various biological techniques in the Department make important contacts with three remaining
Institute’s departments: the Department of Cellular Biochemistry, the Department of Muscle
Biochemistry and the Department of Cell Biology. Second, the Institute provides outstanding facilities
for our work. In particular, we have an excellent animal house (headed by Maria Walkowska, previous
Department’s member) and library with almost all neuroscience journals.

The Department has always maintained vivid contacts with other neuroscience laboratories in
Poland. Moreover, in some fields it has played an integrative role, e.g., we coordinated a number of
large neuroscience programs in Poland. We have maintained particularly close cooperation with the
Department of Neurosurgery, Medical Research Centre (headed by Lucjan Stepień, who was also the
member of our Department, and later by Eugeniusz Mempel), the Department of Bionics, Institute of
Biocybernetics and Biomedical Engineering (headed by Ryszard Gawroński and later by Wojciech
Zmysłowski), the Department of Anatomy, Medical Academy in Gdańsk (headed by Olgiert
Narkiewicz) and the Department of Animal Physiology, University of Łódź (headed by Andrzej
Romaniuk).

We have also been collaborating with many foreign laboratories. About 250 foreign guests
presented their results in the Department, some of them visit us every few years. We had about 50
foreign visitors, from East and West, working in the Department for at least three months. Some of our
long-term and/or frequent visitors influenced strongly our work. Among these are: Jim Brennan, Ivan
Divac, George Gerstein, Pawel Hnik, Adrian Morrison, Tomasz Radil, Guy Santibánez and Jeffrey
Wilson. We also owe a lot to some other foreign friends: Giorgio Bignami, Roberst Brush, Jan Bureš,
Pierre Buser, Robert W. Doty, Giuseppe Moruzzi, Giancarlo Pepeu, Steve Rose, Pavel Simonov, Jim
Sprague, Michael Stewart, Holger Ursin and Clinton Woolsey. Many collaborations and the
participation of many our workers in the international conferences were sponsored by international
organizations, in particular by IBRQ and the European Training Programme in Brain and Behaviour
Research. The Department publishes a well established international journal Acta Neurobiologae
Experimentalis (until 1970, its title was Acta Biologiae Experimentalis).

We have very close relations with the Laboratory of Neuropsychology in Bethesda and the Institute
of Neurological Sciences in Philadelphia. A number of NIH projects with these institutions (in
Bethesda the project officers were H. Enger Rosvold, Patricia Goldman-Rakic and Mortimer Mishkin,
and in Philadelphia, William Chambers and Eliot Stellar) had an important mutual impact. In the years
1958-1988 working conferences were organized every three years by our Department, the Institute of
Higher Nervous Activity and Neurophysiology in Moscow and the Institute of Physiology in Prague.
Jerzy Konorski, Ezras Asratyan and Ernest Gutmann were the organizers of the first conference held in
Poland.

The Department is a place where Western and Eastern neuroscientists meet frequently. This
particularly happens during international symposia organized by the Department. A good example is
“The Warsaw colloquium on instrumental conditioning and brain research” (see Żernicki and Zielinski
1979), where half of the participants were from Eastern and half from Western countries. Many of our
workers moved abroad for various reasons, not only scientific, but also political, personal and financial
as the funds for conducting research are scarce and the wages of scientists ridiculously low in Poland.
The majority of these colleagues remained scientifically active and stay in close contact with us. These
are: Marek Celiński, Jan Bruner, Jolanta Chmielowska, Bogdan Dreher, Bella Harutunian-Kozak,
Krystyna Jablonowska-Ciesielski, Elżbieta Jankowska, Paweł Jastreboff, Lech Kiedrowski, Ewa
Kostarczyk, Włodzimierz Kozak, Grażyna Markow-Rajkowska, Alicja Markowska, Zygmunt Pizło,
Anna Potempska, Janusz Rajkowski, Ewa Rożkowska-Ruttiman, Stanisław Sobótka, Stefan Sołtysik, Bolek Srebro, Iwona Stepniawska, Jolanta Ulas, Klaudiusz Weiss, Andrzej Wieraszko, Wanda Wyrwicka and Andrzej Żброżyna. At the 75th anniversary of the Institute we were not in the position to invite our numerous foreign friends because of financial limitations. However, we invited previous members of the Institute and many of them could attend the anniversary conference.

A number of Department’s workers died. It was particularly difficult to accept the death of these who left as young persons. These were Stefan Brutkowski, Jadwiga Dąbrowska and Renard Korczyński.

The Department has obtained important results in the majority of fields of neuroscience, but it is concentrated on various aspects of neural plasticity (learning and memory, development driven by sensory stimulation, recovery of function after brain damage). It is beyond the scope of this article to review systematically the Department’s achievements. I will only mention some representative results, characterizing the past and the present lines of research. Many of our papers were published in Acta Neurobiologiae Experimentalis; some are in the proceedings of symposia organized by the Department (Konorski et al. 1972, Doty et al. 1973/1974, Żernicki and Zielinśki 1979/1980, Oderfeld-Nowak et al. 1990). Some of our results were described in detail in Konorski’s monograph (1967) and in review papers (Brutkowski 1965, Konorski 1968, Fonberg 1986, Żernicki 1986, 1991, Kossut 1992).

**Conditioning.** Konorski (1948) presented a concept of neuronal plasticity and a concept that the mechanism of conditioned reflexes is based on the Sherringtonian principles of functioning of the central nervous system. Konorski and Szwejkowska (1952) described the principle of the primacy of the first conditioned-reflex training. Wyrwicka (1952) provided evidence that there are double connections linking the “center” of the conditioned stimulus with the “center” of the instrumental motor act; one of them is indirect, through the drive “center”. Tarnecki (1962) demonstrated that it is easy to instrumentalize a movement elicited by electrical stimulation of the sensory cortex but not the motor cortex. Sołtysik and Kowalska (1960) determined the relations between classical and instrumental components in defensive conditioning. Górska and Jankowska (1961) found that proprioceptive feedback plays a minimal role in the instrumental conditioned reflex. Walasek et al. (in press) found a bidirectional effect of novel stimuli on the bar pressing response in rats. Łukaszewska and Niewiadomska (in press) found that discrimination learning is better in spontaneously hypertensive rats than in normotensive controls. Dobrzańska (1978) described social learning in ants and Godzińska et al. (1992) rapid escape learning in bumblebees.

**Prefrontal cortex.** It was found that after prefrontal lesions in dogs the inhibitory conditioned reflexes are disinhibited (Brutkowski et al. 1956, Dąbrowska 1972, Brennan et al. 1976). Zielinśki (1972) showed that the short-latency avoidance responses are severely impaired in prefrontal cats. Stępień (1974) found that in prefrontal dogs the response to the conditioned stimulus location is enhanced. Dreher and Żernicki (1969) described the impairment of habituation of the ocular orienting reflex in prefrontal cats. Ławicka and Konorski (1959) and Stasiak and Ławicka (1990) found, respectively, that following prefrontal lesions in dogs the delayed responses and responses in the Konorski Test for short-term memory are impaired. Kosmal and associates (Kosmal 1981, Markow-Rajkowska and Kosmal 1987) described the distribution of afferents to frontal cortex in dogs.

Limbic system. Fonberg (1958) presented a concept on the role of fear in neurotic states. Fonberg and associates (see Fonberg 1986) discovered the inhibitory and excitatory role of two antagonistic parts of amygdala in motivation, emotional disorders and conditioned responses. Zagrodzka and Fonberg (1978) determined neural mechanism of the predatory behavior in cats. Kostarczyk and Fonberg (1982) determined the role of autonomic changes in the mechanisms of alimentary and social rewards in dogs. Werka and Marek (1990) found that amygdala is strongly involved in the control of post-stress analgesia. Srebro et al. (1973) showed that the destruction of specific septal nuclei evoked the degeneration of cholinergic fibers in the hippocampus.

Sensory systems. Using behavioural and electrophysiological methods Grabowska (1983) and Sobótka et al. (1984) showed in man that visual information is differently processed and stored in the left and right hemispheres. Walerjan and Tarnecki (1991) developed a new mapping technique for analysis of cerebral electrical activity in man. Harutiunian et al. (1970) and Turlejski (1975) described visual single unit responses in the tecto-pretectal region and in the lateral suprasylvian cortex, respectively, in the awake cat’s cerebrum. Dec et al. (1978) described visual responses in cat’s isolated midbrain. Wróbel (1982) proposed a new model for the circuitry of the lateral geniculate body and Wróbel et al. (1994) found the specific activity within beta frequency band (about 20 Hz) appearing in the cat’s visual cortex and lateral geniculate nucleus during attentive visual behaviour. Dobrzecka et al. (1965) found direct sensori-motor pathway in dog’s cerebral cortex for the “specific tactile stimulus”. Chmielowska et al. (1986) mapped the vibrissal projections to the first somatosensory cortex of mice with 2-deoxyglucose and with this technique Kossut and Siucińska (1993) discovered reversible changes in the cortical body maps of vibrissal receptors resulting from classical conditioning training that involved stimulation of vibrissae. Korda (1974) described critical factors determining parental behavior in dogs. Chmurzyński (1964) identified mechanisms underlying stages of spatial orientation in the digger wasp Bembix rostrata.


Development. Jabłonowska and Budohoska (1976), Kołtuska and Grabowska (1992) and Szeląg et al. (1992) provided evidence that brain lateralization develops in ontogenesis and can be influenced by individual experience. Wyrwicka (1959) and Ławicka (1989) described impairment of the detour behaviour and delayed response learning, respectively, in cage-reared animals. Zablocka et al. (1980) found that in cats deprived visually in the early period of life, the role of the superior colliculus in visual learning is increased. Michalski et al. (1984) found that one of the ways in which visual deprivation affects neuronal responses is by altering the interneuronal connectivity in primary visual cortex. Głażewski et al. (1992) found a correlation between functional plasticity of the barrel cortex and the development of mature activity of voltage dependent calcium channels and NMDA receptors. Dobrzanski (1971) described rapid manipulatory learning in young ants.

Recovery from brain damage. Ślósarska and Żernicki (1971) found that the sleep-waking cycle recovers in chronic pretrigeminal and cereveau isolé cats. Oderfeld-Nowak et al. (1984) found in rats that administration of exogenous gangliosides facilitates recovery from brain damage.

Peripheral nervous system. Lubińska, Niemierko and associates (Lubińska et al. 1963, Lubińska and Niemierko 1971) discovered bidirectional flow of the axoplasm. Skangiel-Kramska and Niemierko (1975) found the soluble form of acetocholinesterase in peripheral nerves.
TABLE I

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<td>ZAGRODZKA Jolanta</td>
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<tr>
<td>ZERNICKI Bogusława</td>
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</table>
The current research interests of individual Department’s members can be found in Table I. A few of these researchers and 15 not listed young fellows working for the Ph.D. constitute a fourth generation of researchers of the Department. A large group of highly experienced and devoted technical workers contributed greatly to the progress of the Department. A few of them are: the late Antoni Rosiak, animal caretaker, the late engineer Józef Folga, the late Ewa Stajudowa, the managing editor of Acta Neurobiologicae ExperimentaliS and Maria Raurowicz, the retired worker of the surgery room.

At present 12 laboratories constitute the Department of Neurophysiology: Laboratory of Visual Perception (head, Bogusław Żernicki), Laboratory of Afferent Systems (head, Remigiusz Tarnecki), Laboratory of Psychophysics (head, Anna Grabowska), Laboratory of Defensive Conditioned Reflexes (head, Kazimierz Zieliński), Laboratory of Cortical Plasticity (head, Małgorzata Kossut), Laboratory of the Limbic System (head Jolanta Zagrodzka), Laboratory of Motor Control (head, Teresa Górsk), Laboratory of Neurochemistry (head, Barbara Oderfeld-Nowak), Laboratory of Ethology (head, Jerzy Chmurzyński), Laboratory of Neuroanatomy (head, Anna Kosmal), Laboratory of Visual System (head, Andrzej Wróbel) and Laboratory of Molecular Basis of Brain Plasticity (head, Jolanta Skangiel-Kramska). In addition, Tissue Culture Unit (head, Leszek Kaczmarek) is scientifically a part of the Department.

The Department is a large, interdisciplinary and active neuroscience center. The presence of various lines of neurobiological research in the Department as well as a large and experienced group of researchers in other Institute’s departments form a fertile ground for cross-breeding of ideas and borrowing of techniques. The new generation of neuroscientists grows in this unique multidisciplinary environment that is most suitable for modern neuroscience.

I thank Wacława Ławicka, Krzysztof Turlejski and Kazimierz Zieliński for comments.

REFERENCES


Paper presented at the Conference on 75-th Anniversary of the Nencki Institute