論文内容の要旨

論文題目

Establishing a comprehensive online database containing information of *Drosophila* brain neurons

(ショウジョウバエ脳の神経情報を収集する網羅的オンラインデータベースの構築)

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The fruit fly *Drosophila melanogaster* has been adopted as a model animal, not only in genetics and developmental biology but also in neurobiological science. It is estimated that there are as many as 100,000 neurons in a fly brain. Information on numerous types of neurons of *Drosophila* central and sensory nervous systems has been accumulated during its history of research over the past 100 years. In spite of this, however, databases that comprehensively collect information of all the identified neurons have never been released.

Moreover, molecular genetical methods such as the enhancer-trap technique are used frequently in recent researches to identify, visualize, or manipulate specific neurons. As each enhancer-trap strain drives gene expression in different subsets of neurons specifically, consolidating information of useful strains and the neurons labeled by them is highly demanded. This kind of database has never been established, either. In this research, I constructed an online neuron database called Flybrain Neuron Database, which provides information of neurons and enhancer-trap strains to label them. The database aims to archive information of as many neurons as have ever been identified.

To construct the database system, commercial database software FileMaker Pro 8.5 (FileMaker Inc.) was adopted as the platform. It was chosen because of its versatility in dealing with various types of data fields including text, figures and movies using graphic user interface, so that data can be added to the database easily and intuitively. Also, the software supports flexible relational database function, which enables to correlate multiple sub-databases in the system.

The database is composed of four major sub-databases. The first part – Neuron database – contains information of each identified neuron type, including systematic fields for neuron names, number of the cells, projection sites and distribution of pre- and postsynaptic, and free-text fields for morphological and functional descriptions. Figures or movies were provided whenever possible to present morphologies of the neurons. Information was collected mainly from original publications of various research groups including ours, as well as some unpublished data annotated by us and collaborators. Neuron types described in the database are visualized mostly with enhancer-trap strains or immunostaining. These markers, on the other hand, often label not only one neuron type but rather several or many of them. To present these labeling patterns systematically, I set up the second sub-database – the Strain/Antibody database. Each record of this sub-database contains information about specific strain or antibody, which is mutually hyperlinked with the Neuron database data of the neurons labeled by the strain/antibody.

Projection sites and positions of the cell bodies are described based on the strictly defined brain regions. The third sub-database – Brain Region database – provides detailed explanation and definition of these areas, which are based on the controlled nomenclature system established newly by the consortium of insect neurobiologists, for which I made substantial contribution by making draft proposal and the final plan accommodating suggestions by other members. Therefore this study of establishment of the new nomenclature of neuropils occupies a significant part of this work to construct the neuron database.

Collaborating with informatics researchers in the National Institute of Advanced Industrial Science and Technology, I also incorporated a novel interactive three-dimensional online browser – the Brain Explorer. It enables users to view the stacks of serial optical brain slices from any desired viewing angle with any cutting plane. Each record of the Brain Explorer is hyperlinked with relevant records of the Neuron database and/or the Strain/Antibody database.

The database also offers active links to external databases such as PubMed, FlyBase or Drosophila Stock Center so that users can easily obtain detailed publication data or request specific fly strains.

More than 400 different types of neurons have been registered in the Neuron database, covering most of the neurons identified in the fly brain. The so far unprecedented comprehensive and interactive lists of all the known neurons will serve as a useful daily tool for fly neuroscientists. The comprehensive information of neuronal projection will also be utilized to estimate connectivity between certain areas of the brain. Variety of connectivity strengths within the optic lobe layers have successfully been evaluated using the datasets. Connectivity strengths between higher-order neuropils will be calculated as well after enough amount of information of higher-order interneurons is accumulated.