Netherlands Brain Bank

Progress Report 2009-2010

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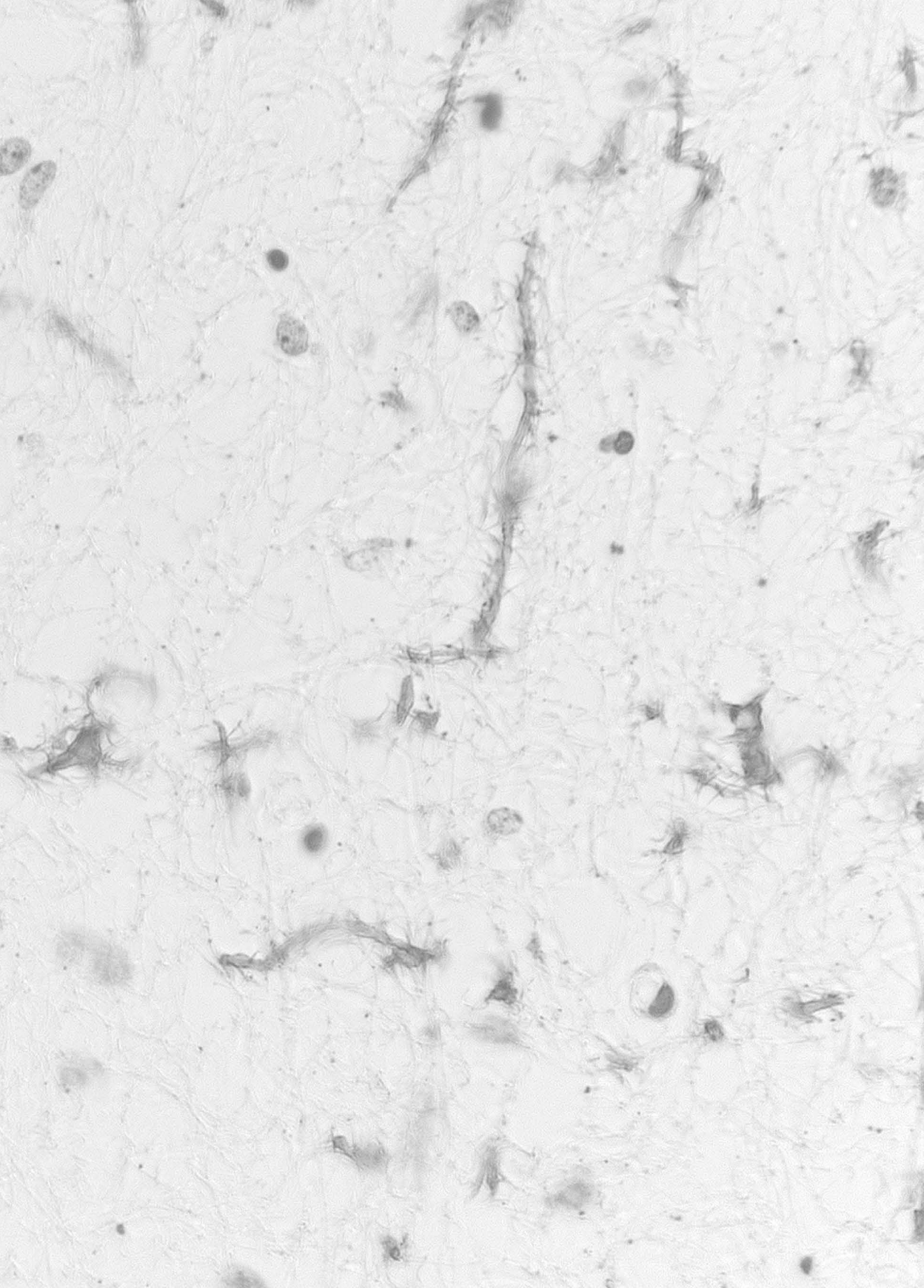


Introduction

It is with great pleasure that I present the 2009/2010 progress report of the Netherlands Brain Bank (NBB). The primary activities of the NBB are to motivate people to register as brain donor, to perform autopsies and to disseminate tissue to researchers worldwide. In 2006 we professionalized all NBB procedures, from procurement and storage to dissemination to researchers. New informed consent forms, informational DVDs, improved tissue application procedures, advisory committees and increased public relation activities were all effective, resulting in increased numbers of donor registrations and autopsies. The number of annual registrations increased from 180 in 2006 up to a steady 290 in 2008-2010. Since the foundation of the NBB in 1985 the annual numbers of autopsies have kept climbing. In 2006, 82 autopsies were recorded and in 2010 the NBB reached the record autopsy number of 127!

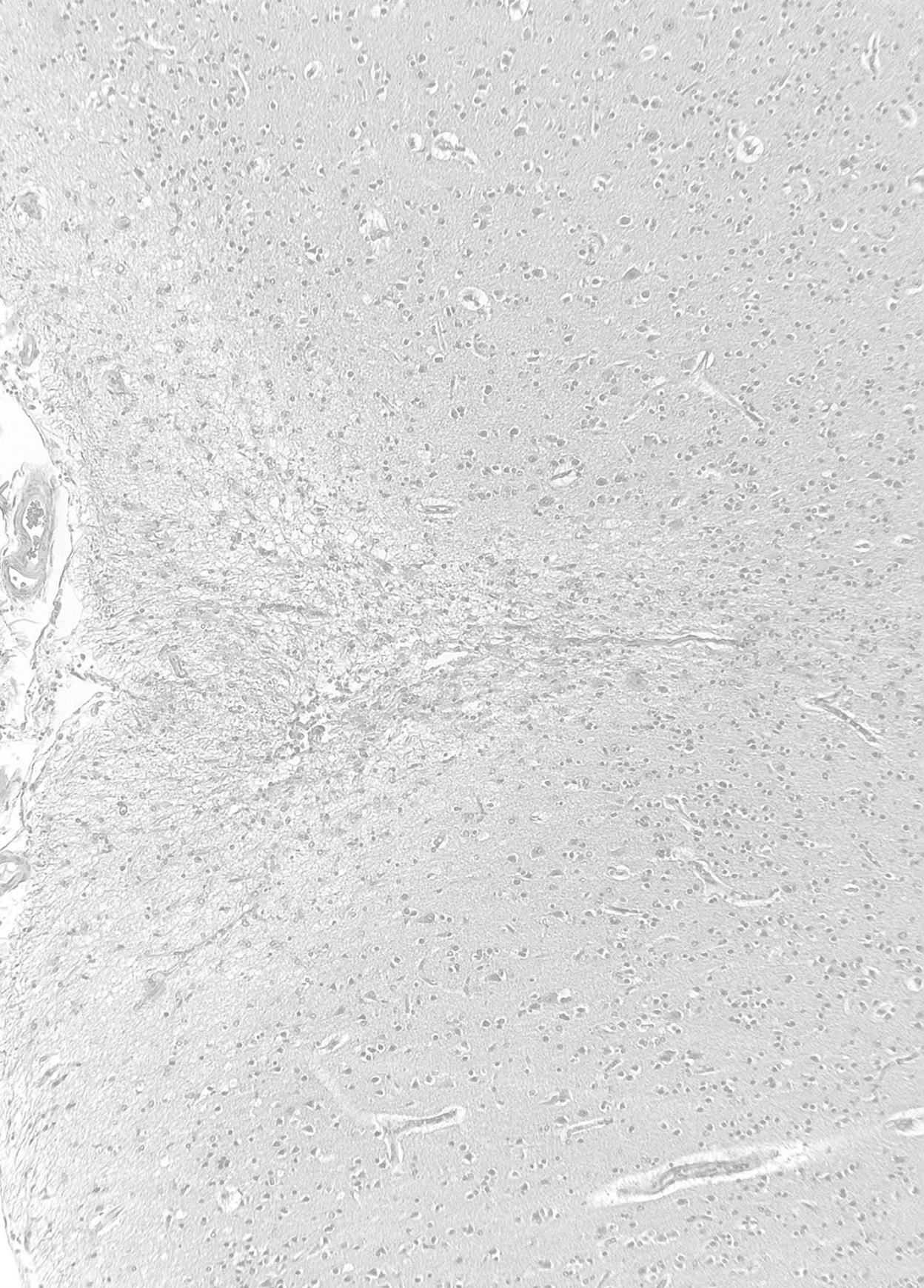
After the successful reactivation of donor programs and the professionalization of brain banking procedures, we have now reached a point where our donor programs need more focus. To ensure a more effective dissemination of tissue we shall need to gear any new donor registrations to the most frequently requested types of tissues. In the coming years our focus will thus be on brain diseases for which we receive many tissue requests, and on patients who participate in clinical cohorts and are therefore well-documented. As a consequence, the registration of complex cases that are seldom requested by researchers will have a lower priority.

I would like to express my gratitude to the *NIN, KNAW, Stichting MS Research, Internationale Stichting Alzheimer Onderzoek, Internationaal Parkinson Fonds* and *Hersenstichting Nederland*, as well as to private backers, for their financial support, which is indispensible for the continuation of the NBB.

I also thank the members of the autopsy team for their guidance and help with the autopsies, day or night. Many of these are PhD students and technicians, who have volunteered to help us out despite their own busy programs and work commitments. Also indispensible are the autopsy assistants and pathologists at VUmc, to whom I would like to express my gratitude for their willingness to perform the autopsies.

Last but not least, I thank the donors, without whose willingness to donate their brain, worldwide scientific research of the brain and brain disease would not be possible.

Inge Huitinga
Director Netherlands Brain Bank

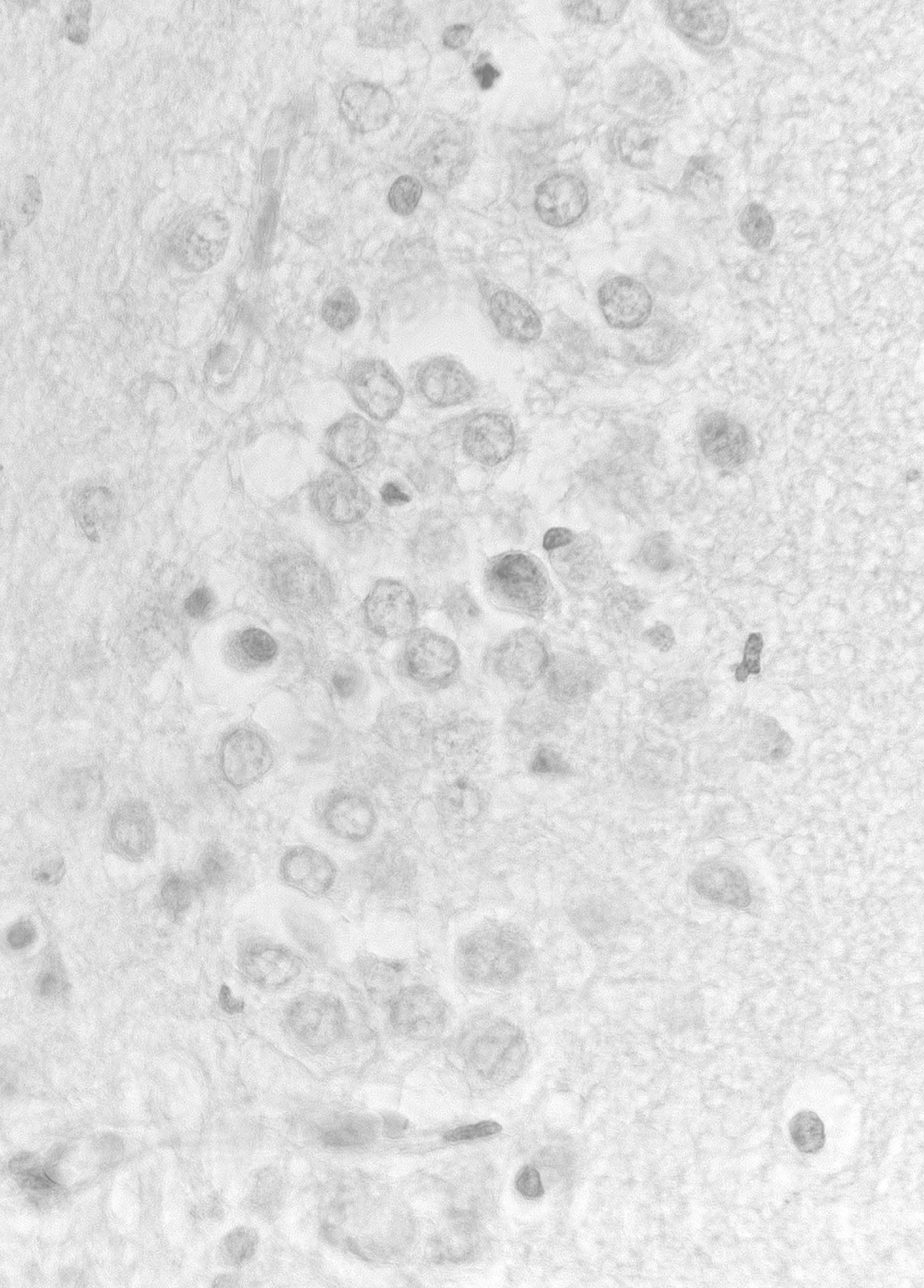


Objectives NBB

The Netherlands Brain bank was founded in 1985 by Professor Dick Swaab (1944) to obtain brain tissue for his Alzheimer research. While setting up an infrastructure to register Dutch people for a rapid brain autopsy for research purposes, he realized that such a facility would be of great value also for other researchers in neuroscience. The NBB has thus been open to tissue applications from researchers worldwide from the very start.

The primary objective of the NBB still is to collect, characterize and disseminate tissue of the human brain and spinal cord for scientific research worldwide. The ultimate goal is to increase knowledge of the human brain and to find cures for neurological and psychiatric brain diseases.

An overview of the current composition of the NBB can be found in the Appendix (Figure 9).



Donor Registrations

The NBB is one of the few brain banks in the world with an active donor program, which means that the NBB actively tries to motivate people with neurological, psychiatric and neuroendocrine disorders, as well as healthy individuals, to register as brain donor at the NBB. With this registration, donors give informed consent to the NBB to perform a rapid autopsy after death and to donate the brain tissue to reviewed research projects around the world. The donors also give permission to the NBB for the release of their medical information after they have passed away. Currently, 2374 living donors with a variety of disorders are registered at the NBB.

New Informed Consent Forms

In 2008, the NBB created new registration forms and accompanying informational brochures (informed consent forms), which are in line with regulations and guidelines issued by international key organizations, such as the Council of Europe, the European Commission, the World Medical Association and the World Health Organization. The informational brochures and registration forms were reviewed by the Medical Ethics Committee of VUmc and officially approved on October 30, 2009.

Biannual Newsletter

In order to inform our donors about the progress made within the NBB and about the scientific output achieved with material provided by the NBB, we initiated a biannual Newsletter for all our registered donors. The first edition (n = 2250) was issued in April 2009. The NBB received many positive reactions from the registered donors as well as from their relatives. An additional advantage of this large-scale mailing was that it cleaned up our database: 83 registrations (3.7%) could be removed. In some cases the newsletter elicited a notice from a family that the prospective donor had already passed away. The most frequently given reason why the NBB had not been contacted at time of death was that the spouse or children found the prospect of a brain autopsy too difficult.

Registrations

Figure 1 shows the number of registrations in 2009 and 2010, compared to the registrations in the period 2007-2008. The total number of registrations in 2009/2010 increased slightly in comparison with those in 2007/2008 (545 vs. 513), although the

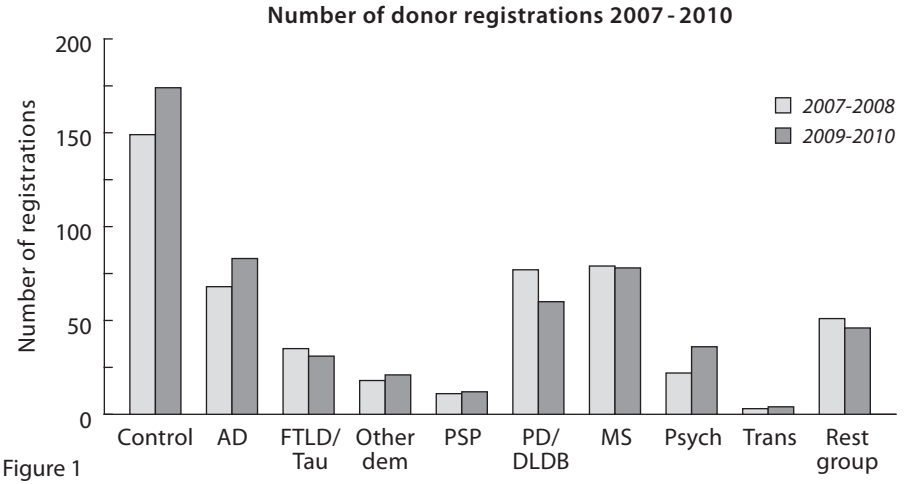


Figure 1

registrations did not increase for every diagnosis. The NBB is very pleased with the increase of donors with psychiatric disorders (depression, schizophrenia). The increase for multiple sclerosis (MS) and non-demented control donors is probably due to the promotional DVDs which can be ordered via our Dutch website. Especially the MS DVD 'De Oplossing zit in de Hersenen' is frequently ordered by (potential) donors: 130 times since its release in 2007. It gives an elaborate overview of the procedures of the NBB with regard to MS. In the last two years, the NBB sent more than 1000 information packs to individuals, neurologists and nursing home physicians (Table 1). The registration forms can also be downloaded from our website.

In total we received 268 new registrations in 2009 and 277 new registrations in 2010 (Figure 2). After the increase in annual registrations from 2007 onward, the number of registrations per year now seems to have stabilized. The number of new female registrations remains higher than that of new male registrations. This might

Table 1 PR Material NBB

Information pack	2009	% registered	2010	% registered
Informed consent	194	40%	132	38%
Authorization	23		11	
Informed consent via physician	221		155	
Authorization via physician	179		140	
Total number of information packs sent	*617*		*438*	

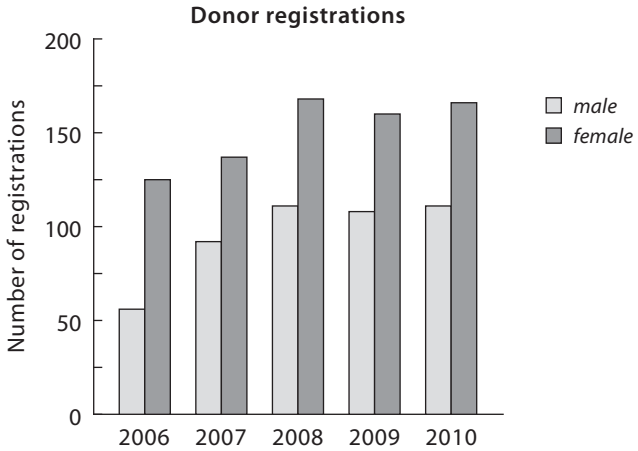


Figure 2

be caused by the increase of female MS and non-demented control registrations. The higher prevalence of MS (two-fold) in females probably explains this. As to the disproportionate increase of female control donors, we are as yet unable to offer an explanation for this development. This difference between the numbers of male and female registrations is not seen in organ donation for transplantation purposes (source: www.donorvoorlichting.nl).

The increase in the total numbers of annual registrations is reflected in the annual number of autopsies, which has increased from 82 in 2006 to 127 in 2010 (Table 3). Indeed, 46 % of the registrations occur in the year before autopsy (Table 4).

Increased focus of the NBB donor program

The NBB shifted its focus from general donor recruitment to recruitment from clinical cohorts. Many academic hospitals have clinical cohorts of patients with a specific neurological or psychiatric disorder to study disease course and the effect of experimental therapies. These patients are studied longitudinally and therefore many medical data are available in a standardized manner. This makes them a very interesting group for post mortem research. Moreover, these people - willing to participate in research during life - tend to be willing to donate tissue after their demise as well.

Presentations and articles

In the past two years the NBB has spent a great deal of time and effort into raising awareness of the importance of research with human brain tissue and the possibility of brain donation. We visited patient meetings to give presentations on the work

of the NBB and the possibility to become a donor. Being able to show the kind of research that is performed on tissue donated to the NBB - research that might help find a cure - evokes many positive reactions and has led to many new donor registrations. Table 2 gives an overview of the articles that were published about the work of the NBB in 2009 and 2010. We always make sure to mention that not only patients with neurological or psychiatric diseases, but also healthy control donors are crucial for good scientific research. In that way, we may also persuade many non-diseased family members to register as brain donor.

Websites of the NBB

Nowadays the internet is a very popular source for patients trying to learn more about their illness. By making sure that the NBB is mentioned on the websites of the various patient organizations, we try to enhance public awareness of the importance of brain donation. Also our donor website (www.hersenbank.nl) is updated regularly to inform our (potential) donors about the work of the NBB. The English website of the NBB (www.brainbank.nl) has been renewed for the sake of convenience for researchers and now provides more information on our procedures, diagnostics and the availability of tissue.

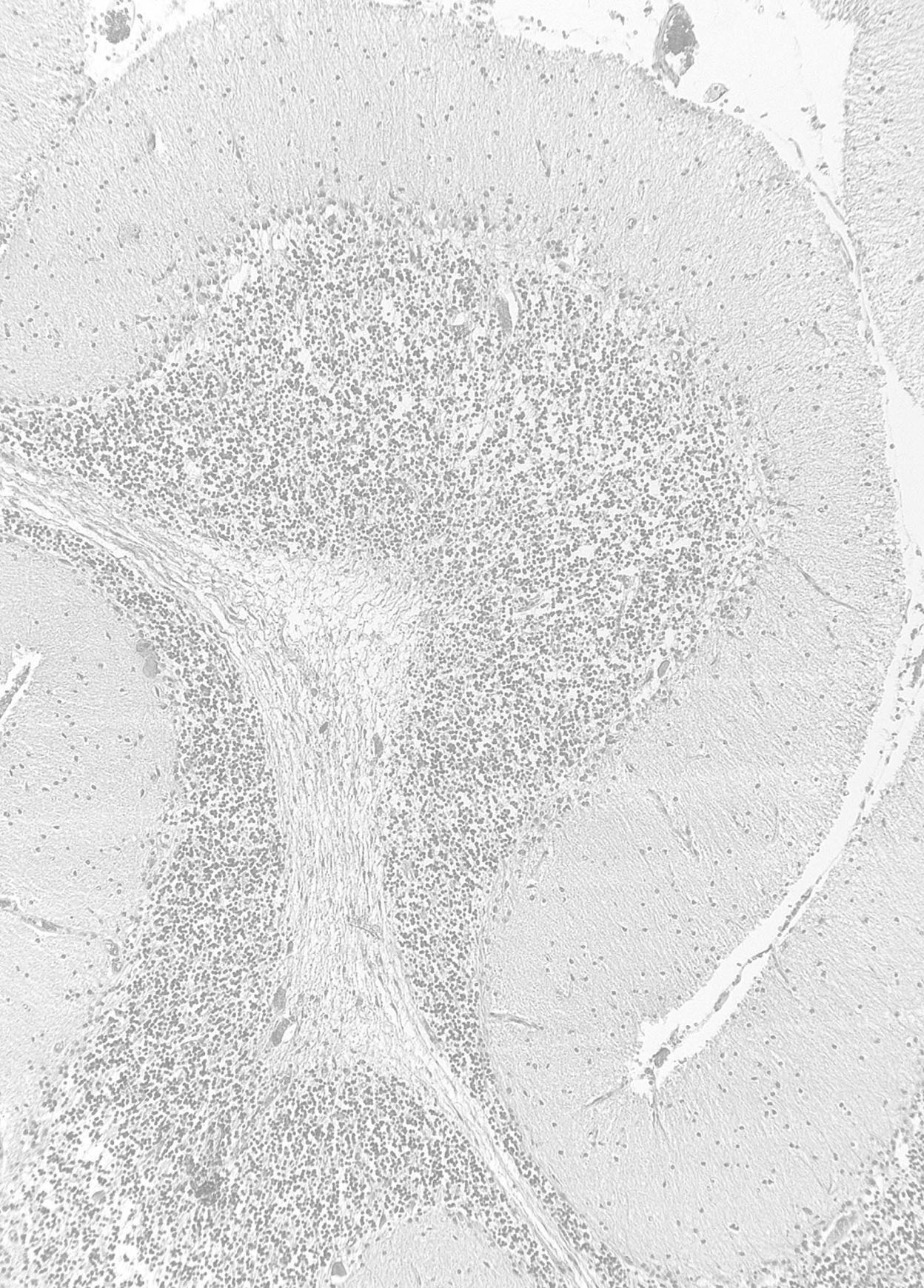
Table 2 Overview of PR activities in 2009 and 2010

Date	Article / presentation	Media
01-01-09	Interview technical coordinator NBB	Noorderlicht (radio show)
01-02-09	Interview director NBB	De Praktijk (radio show)
01-05-09	Radio commercial by director NBB	Radio commercial as part of World MS Day
01-09-09	'It is our mission to find solutions for brain diseases'	HersenMagazine (Magazine of patient organization)
04-10-09	Information stand	National Science Day in the Academic Medical Centre
01-10-09	Information stand	Publieksdag Hersenstichting Nederland
01-11-09	Radio commercial by director NBB	Radio commercial for MS Research is repeated
07-11-09	'MS research and the NBB'	Theme day of MSVN, Schagen
1-2-2010	'Looking the last will in the eye'	TV guide VPRO
1-6-2010	'A brain never gets normal'	Volkskrant (Daily newspaper)
01-06-10	'Brain researchers by accident'	Volkskrant (Daily newspaper)

Future plans

In the upcoming years the NBB will continue to pay special attention to people with psychiatric disorders such as autism, depression, schizophrenia and various addictions. Even though most psychiatric patients are able to give informed consent, they are often reluctant to register as donors at the NBB. The NBB will therefore continue to work together with physicians, psychiatrists and psychiatric nurses to inform patients in clinical cohorts about the importance of brain donation.

The NBB wishes to acknowledge and thank all donors and their families for their generosity and the invaluable gift they are giving to future generations.



Autopsies

Increase in annual number of autopsies

Since 1985 the NBB has performed over 3400 brain autopsies in all. The NBB performed 110 autopsies in 2009 and 127 in 2010. Table 3 shows the number of autopsies per year over the last 5 years, clearly showing that the total number of annual autopsies is increasing.

In the last five years, the number of autopsies per month ranged from 1 to 19. The fluctuations per month, however, show no significant differences of numbers of autopsies per month between the different months of the year ($p = 0.4$, Kruskal–Wallis one-way analysis of variance).

Relation between registration and autopsy

Based on the difference between year of registration and year of autopsy, the NBB calculated the average duration of the registration specified by the neuropathological diagnosis (Table 4). Interestingly, the number of registrations in the year of demise is generally double that of one year before demise. Moreover, 46 % of the registrations occur during the year of, or one year prior to, demise. However, this does not apply for the non-demented control group, where the duration of registration fluctuates more. The registration duration of MS donors shows a different pattern, probably caused by the fluctuating course of the disease. This suggests that the moment of

Table 3 Annual numbers of autopsies divided by disease

Diagnosis	2006	2007	2008	2009	2010
Contr	11	12	16	17	13
AD	30	28	30	29	16
FTLD/tau	2	8	15	15	7
Other dem	9	7	13	6	9
PSP	2	3	5	9	4
MS	8	14	10	11	8
PD/DLBD	6	7	12	16	12
Psych	4	2	4	2	2
Other	10	9	5	5	5
PANR					51
Total	*82*	*90*	*110*	*110*	*127*

Table 4 Duration of registration in months, specified by neuropathological diagnosis

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	>15
Contr	23	17	7	8	15	18	9	9	12	5	8	9	9	8	4	6	7
AD	136	65	45	53	29	19	16	8	4	4	4	5	2	2	2		2
FTLD/tau	30	15	7	7	3	8	2	6	1		3	1					
Other dem	44	20	12	8	5	5	4	1	2	2	3	1	1	2	2	3	1
PSP	18	10	3	1	2	2	1	1	1								
PD/DLBD	43	24	9	6	3	1		4	1	2	5	2		2		1	1
MS	13	6	7	6	6	12	8	5	9	5	6	7	7	3	2	3	6
Psych	9	2	2	4	1				2		1	1	1	1	2		1
Rest group	27	24	8	8	5	4	1	1	1		1		2	1	1		1

registration is motivated by the amount of suffering caused by Alzheimer's disease (AD), but also by understanding the necessity to donate your brain in order to find a cure for brain diseases (MS and controls). Importantly, the results in figure 6 indicate that the increasing number of annual autopsies can be attributed to donor recruitment efforts of the past couple of years.

Mean age of NBB donors at the time of death

The mean age at time of death from the autopsies performed in the period 2006-2010 is 70.8 years for males and 75.5 years for females. However, there are significant differences between the different diagnoses. Figure 3 shows the mean age at time of death (2006-2010) specified by diagnosis. The last column shows the Dutch life expectancy numbers (at birth) of 2009 (source: Centraal Bureau voor de Statistiek, www.cbs.nl), which are 78.8 and 82.6 for male and female respectively. Striking is the lower age at time of death for frontotemporal dementias and multiple sclerosis. These data are in line with the shorter life expectancy for those suffering from these neurological disorders (Hodges et al. 349-54; Sadovnick et al. 991-94; Sumelahti et al. 350-55).

Post mortem delay

Due to autolytic processes, tissue of the central nervous system quickly decays after death and there is thus only a small window of opportunity for brain autopsy. The post mortem delay (PMD: time elapsed from a person's demise to removal of the brain) depends on several factors: time of notification of the donor's death, distance

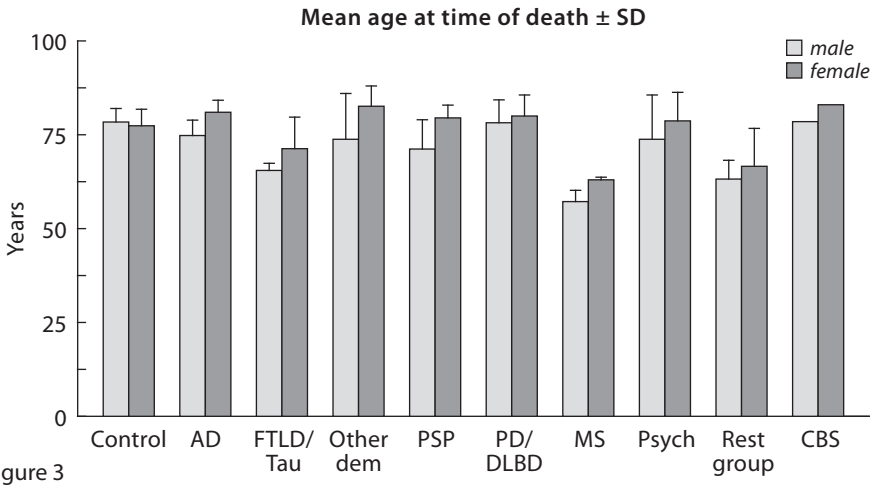


Figure 3

and time for transportation of the corpse and the availability of brain bank staff to perform the autopsy. Because PMD has a strong impact on the quality of the tissue (i.e. RNA, DNA and proteins; see references Chapter BrainNet Europe), several brain banks established rapid autopsy protocols relying on 24/7 availability of staff. The NBB achieves short PMDs, with 65 % of all autopsies having a PMD between 4 to 8 hours, whereas the average PMD of other European brain banks is more than 12 hours, even when they work with a 24/7 availability of staff (manuscript in prep.). Over the last 5 years the average PMD of the NBB autopsies has been extremely stable (Figure 4).

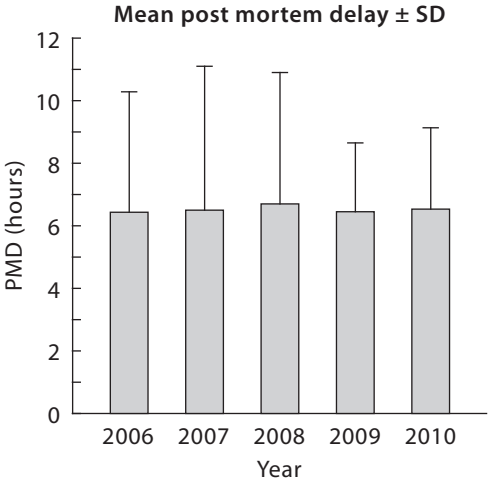


Figure 4

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Tissue Supply

Number of research institutes that receive NBB tissue

In 2006 the NBB undertook to review all its procedures, which led to new informed consent forms and to professionalization of the application and tissue dissemination procedures. A Material Transfer Agreement (MTA) was drafted and put into use, to ensure the rights and obligations of the recipients of the tissue as well as those of the NBB. The first MTA was signed in June 2007. By now the NBB has entered into agreement with more than 70 universities/research institutes and 15 pharmaceutical companies worldwide. Once both parties have signed the MTA, which is valid for an indefinite period of time, any researcher within the institute can apply for tissue.

Number of tissue applications

The number of tissue applications has been on the increase since the introduction of the new procedures, but has stabilized now (Figure 5). Researchers have the possibility to inquire about the availability of samples, which in most cases leads to an application. When it concerns a new research project, the application is reviewed by the NBB's scientific committee. If approved, a new project number is assigned and the necessary paperwork is done, after which the tissue is supplied. The review process takes approximately four weeks. When the application concerns an existing, already reviewed, research project this is called a supplementary application. The option of filing a supplementary application was introduced in 2007, together with

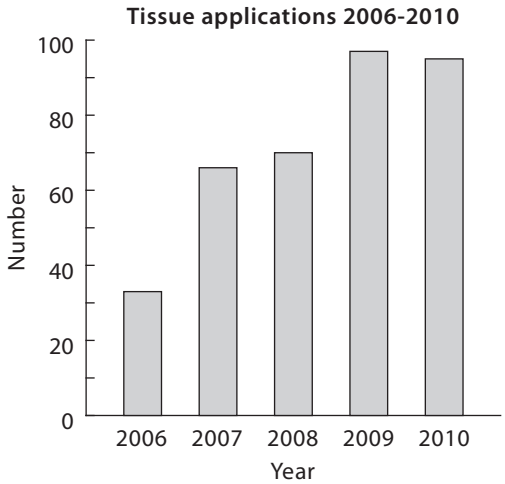


Figure 5

the MTA. With the original research project already approved, the requested tissue, if available, can be supplied even more quickly.

In 2009 and 2010 there were 24 cases (out of 192) where tissue inquiries did not lead to actual applications or where applications could not be approved. Inquiries can be for new applications as well as for supplementary applications. The main reasons why tissue inquiries or applications foundered are:

- an application form was sent to the researcher, but the researcher never actually applied for tissue;
- the researcher had to cancel the application due to financial problems (rejected grant applications);
- the NBB did not have the requested tissue.

The latter shows the need to increase the number of donors with a specific neurological or psychiatric disorder and was one of the reasons to start donor recruitment efforts among clinical cohorts referred to in the section on Donor Registrations.

Tissues disseminated for research projects

Figure 6 shows the specification of supplied samples by diagnosis in 2009 and 2010, compared to the tissue supply in 2007 and 2008. Especially for research on multiple sclerosis and Parkinson's disease more samples were supplied. Also the number of samples supplied from non-demented control donors increased considerably. Thus, in spite of the fact that the number of applications remained stable, numbers of tissue units per application increased.

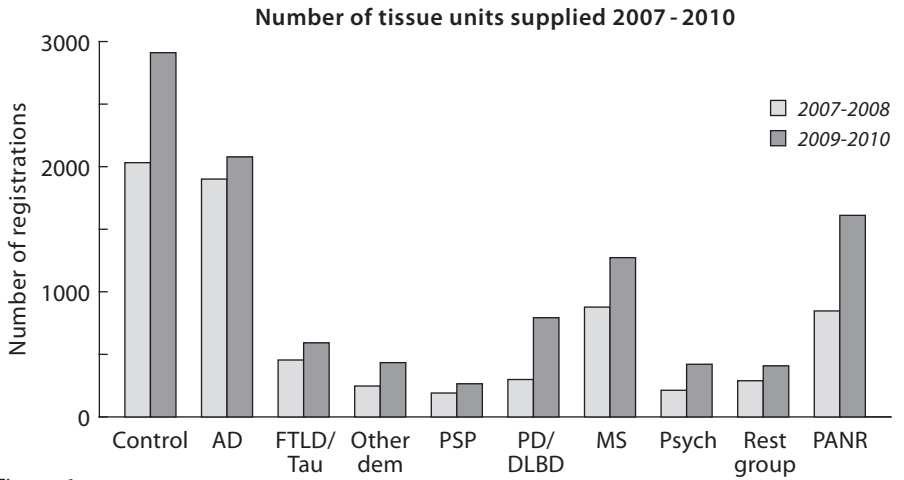


Figure 6

Figure 7 displays the specification of the samples by type of storage. The NBB not only provides frozen or formalin fixed paraffin embedded samples, but also fresh tissue and formalin fixed tissue. The different treatments of the tissue allow the possibility of different kinds of research approaches.

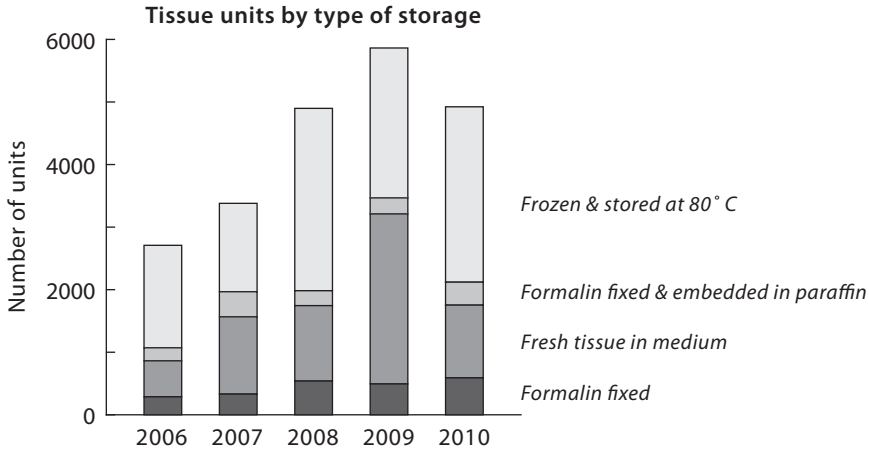
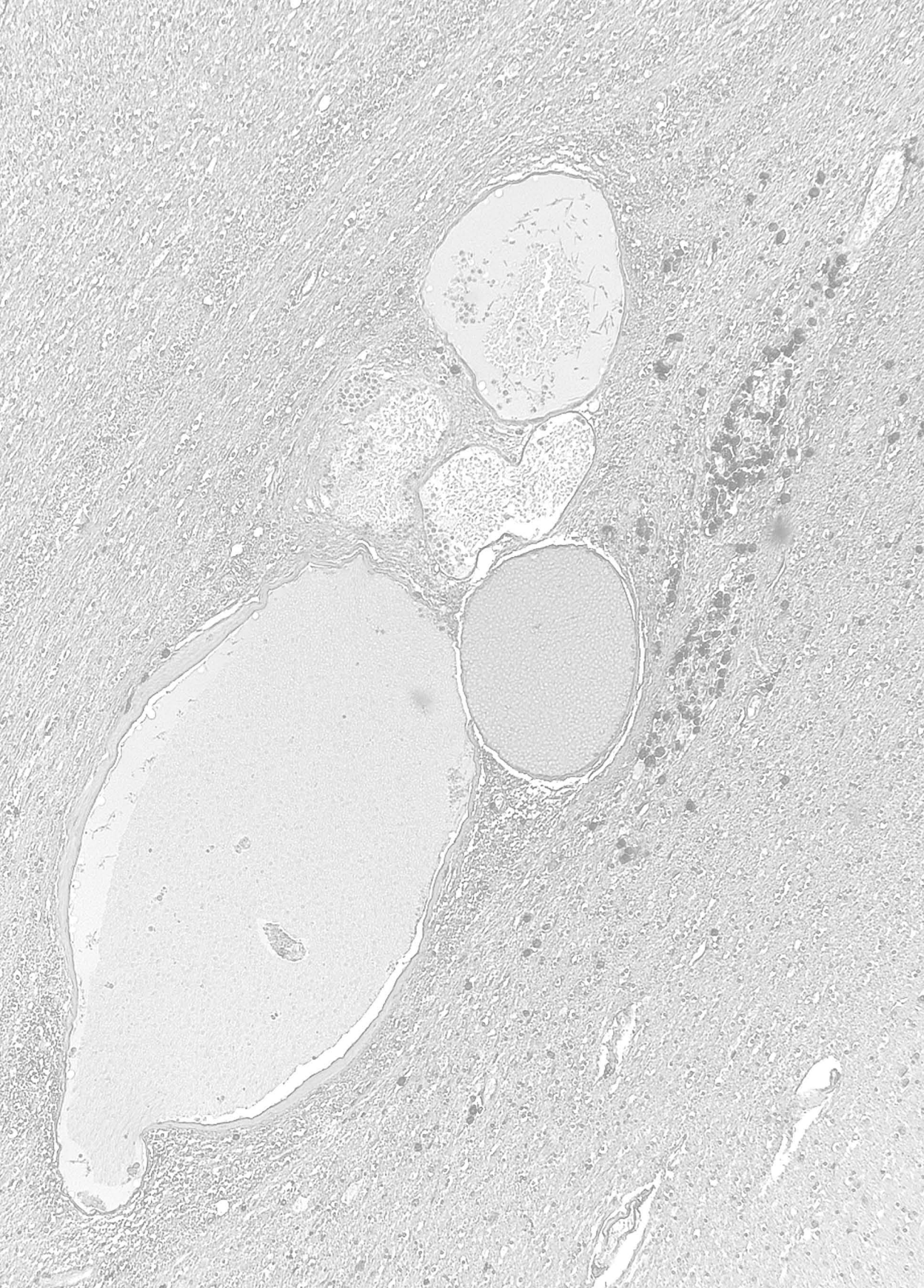


Figure 7



BrainNet Europe

BrainNet Europe II (BNE II) is a 'Network of Excellence', established in the 6th Framework Programme of Life Sciences of the European Commission (FP6) (www.brainnet-europe.org). The Consortium consists of 19 brain banks across Europe. Until 2009, BNE II was funded by the European Commission (EC), in order to carry out work with regard to its objectives, which are, among other things:

- Harmonization of neuropathological diagnostic criteria in Europe;
- Development of gold standards for quality, safety and ethics for obtaining and handling of human tissue;
- Sharing of knowledge and dissemination of the information to neuroscientists and the general public.

Now that the funding by the EC has come to an end, BNE is in transition: from an FP6 funded network it has to transform into a registered BNE Society. All necessary preparations are being made to continue BNE in an independent manner, starting with the BNE Charter which is currently being written.

The NBB has been a longstanding member of the BNE Consortium and an active participant designated to carry out work with regard to the ethical and legal issues in brain banking and recruitment of donors (donor programs).

As the leader of the work package on legal and ethical issues, the NBB has developed a series of documents that should provide a general ethical framework (on Consortium level) and could function as a guideline on the level of the individual organization (on brain bank level). The NBB used a structure that focuses on globally accepted bioethical principles and international doctrine. For this purpose the NBB formulated a BNE Code of Conduct, which covers basic legal rules and bioethical principles involved in brain banking and is based on various sources available in the field of bioethics. Such sources include laws, regulations and guidelines issued by international governmental and non-governmental key organizations, such as the Council of Europe, the European Commission, the World Medical Association and the World Health Organization. In June 2008, all BNE II partners signed the Code of Conduct. The NBB observes all rules and regulations of the Code of Conduct.

The Code of Conduct addresses fundamental topics, such as the rights of the persons donating their tissue, the obligations of the brain bank with regard to respect and observance of such rights, informed consent, confidentiality, the protection of personal data, the collection and management of human biological material, and transparency and accountability within the organization of a brain bank. As the

Code of Conduct only sets a framework of ground rules and general principles, more concrete guidelines are included in another document called the Brain Bank Regulations. To support the daily practice and ensure compliance with the above-mentioned documents, the NBB has also developed a set of model forms and contracts - indispensable for the daily practice of any well-established brain bank. These forms and contracts include Informed Consent forms, Material Transfer Agreements and Confidentiality Agreements and have been made available to all members of the BNE Consortium. Currently the NBB is preparing a publication on the Code of Conduct.

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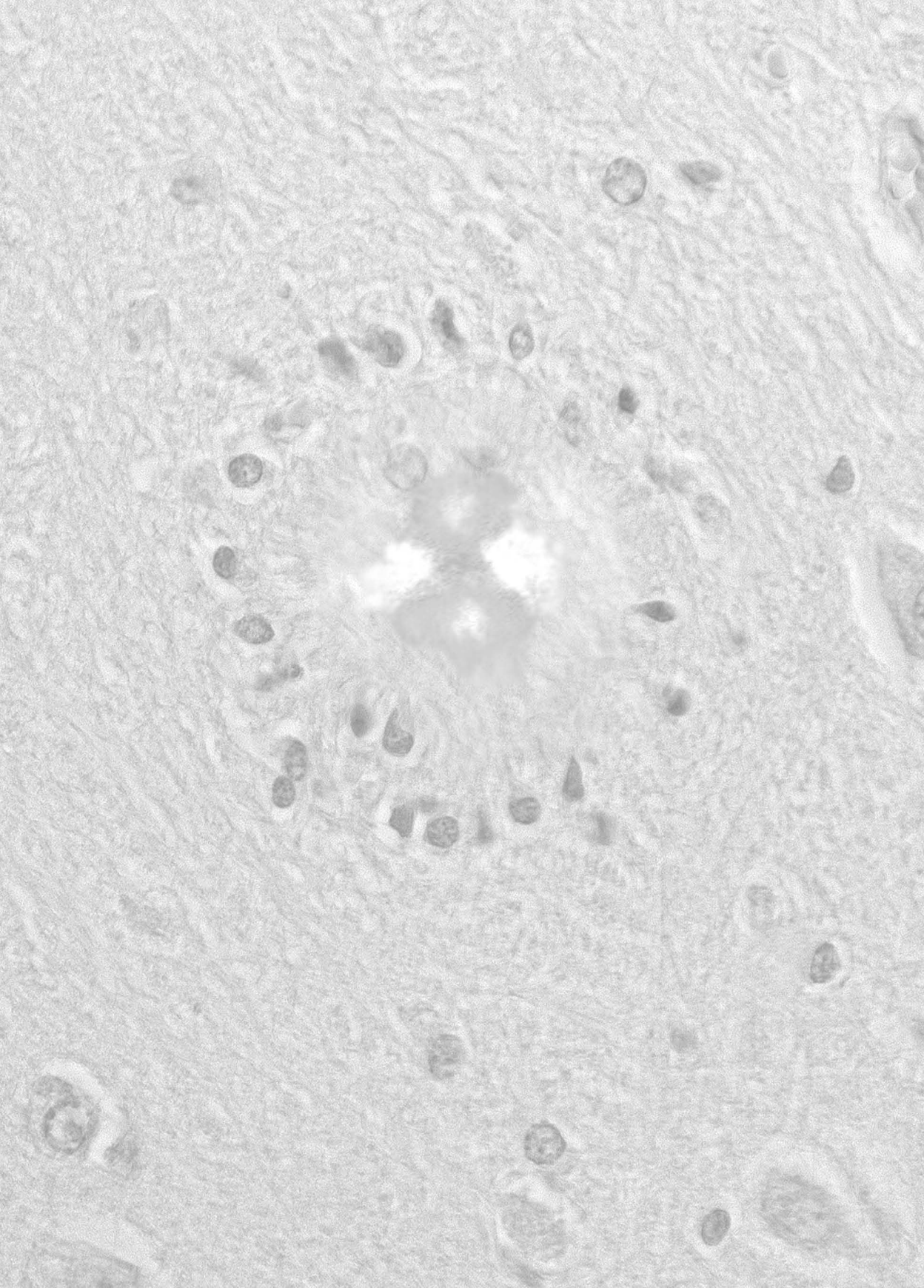

Finances

The NBB receives structural financial support from the KNAW and the NIN, but apart from that it is almost completely dependent upon grants, donations and the financial contributions from researchers who use NBB material.

The "Stichting tot Ondersteuning van de Hersenbank" (Foundation for the Support of the NBB) was founded in 1986 and helps realize the objectives of the NBB by giving financial support. Since January 2008, the foundation has been deemed an 'Algemeen Nut Beogende Instelling" (Institution for Public Advancement) by the Dutch Tax Authority. The assets of this Foundation are formed by donations, testamentary dispositions and legacies (Trade Register Amsterdam, S205869).

The work of the NBB would not be possible without the support of numerous foundations, patient organizations, and the enthusiastic dedication of private individuals.

Grants	**2009**	**2010**
Structural contribution of the KNAW	€ 224,321	€ 224,144
Structural contribution of the NIN	€ 100,000	€ 100,000
Stichting MS Research	€ 109,036	€ 106,253
Internationale Stichting Alzheimer Onderzoek	€ 30,000	€ 17,407
Internationaal Parkinson Fonds	€ 25,000	€ 25,000
Hersenstichting Nederland	€ 10,000	€ 10,000

The necessity of grants

Due to the received funding, the NBB is able to continue brain banking. The costs to make tissue available for research are enormous and continue to grow annually. Without the help of patient organizations the NBB would not be able to maintain its high standards.

The Stichting MS Research (www.msresearch.nl) has funded the NBB for many years, resulting in an increase of the number of MS donors and availability of MS tissue. Due to the special MRI-guided dissection protocol, the autopsy costs for MS are higher than for other autopsies. Moreover, the clinical files of people with MS are often more extensive and the summarization of their medical information requires a greater effort. Finally, in-depth neuropathological diagnostics of the MS plaques is time-consuming, but indispensible for good tissue dissemination. MS Research covers the costs of all MS - and some control - autopsies.

The funding of the Internationale Stichting Alzheimer Onderzoek (www.alzheimer.nl) has made it possible for the NBB to produce a new informative DVD, with the objective to raise awareness on the possibility of brain donation for research purposes, and to start up a DNA bank to keep up with the latest developments in research, where genotyping is becoming the important bridge between clinical and neuropathological characteristics.

The grants of the Internationaal Parkinson Fonds (www.parkinsonfonds.nl) cover the costs of a part of the Parkinson autopsies and some donor recruitment activities, which would not be possible without this extra funding.

Funding of the Hersenstichting Nederland (www.hersenstichting.nl) is used to cover donor recruitment, autopsy and administration costs.

Research Projects 2009-2010

The abstracts can be downloaded from our website (www.brainbank.nl)

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Expression of therapeutic candidate G-protein coupled receptors in the Dorsal Root Ganglia from male and female donors.

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Bayer Schering Pharma AG

Interrelationship of activated microglia & reactive astrocytes in AD.

Characterization of alpha-synuclein binding molecules.

Characterization of small molecules binding to dementia related pathological targets.

Biopta Ltd.

Studies on Isolated Tissues to Investigate Drug Actions.

GlaxoSmithKline

Identification of potential therapeutic targets for amyotrophic lateral sclerosis and Huntington's disease.

Identification and validation of potential therapeutic targets for multiple sclerosis.

Innogenetics

Isolation of native Tau and PHF Tau from brain material.

Loke Diagnostics ApS

Imaging MS on brain tissue samples from Alzheimer's disease (AD) patients.

Neurimmune Therapeutics AG

Development of novel human antibody therapeutics for the treatment of neurodegenerative disorders such as Alzheimer's disease, Parkinson's disease and amyotrophic lateral sclerosis.

NeuroNova AB

Identification and validation of target protein receptors in brain tissue from Parkinson's patients.

Novartis AG

Localization of S1P receptors in MS brain tissue Examination of MS lesions for macrophage activation and inhibitory markers'

Pfizer Ltd.

Pharmacological profiling of allergy related targets known to be expressed in brain frontal cortex.

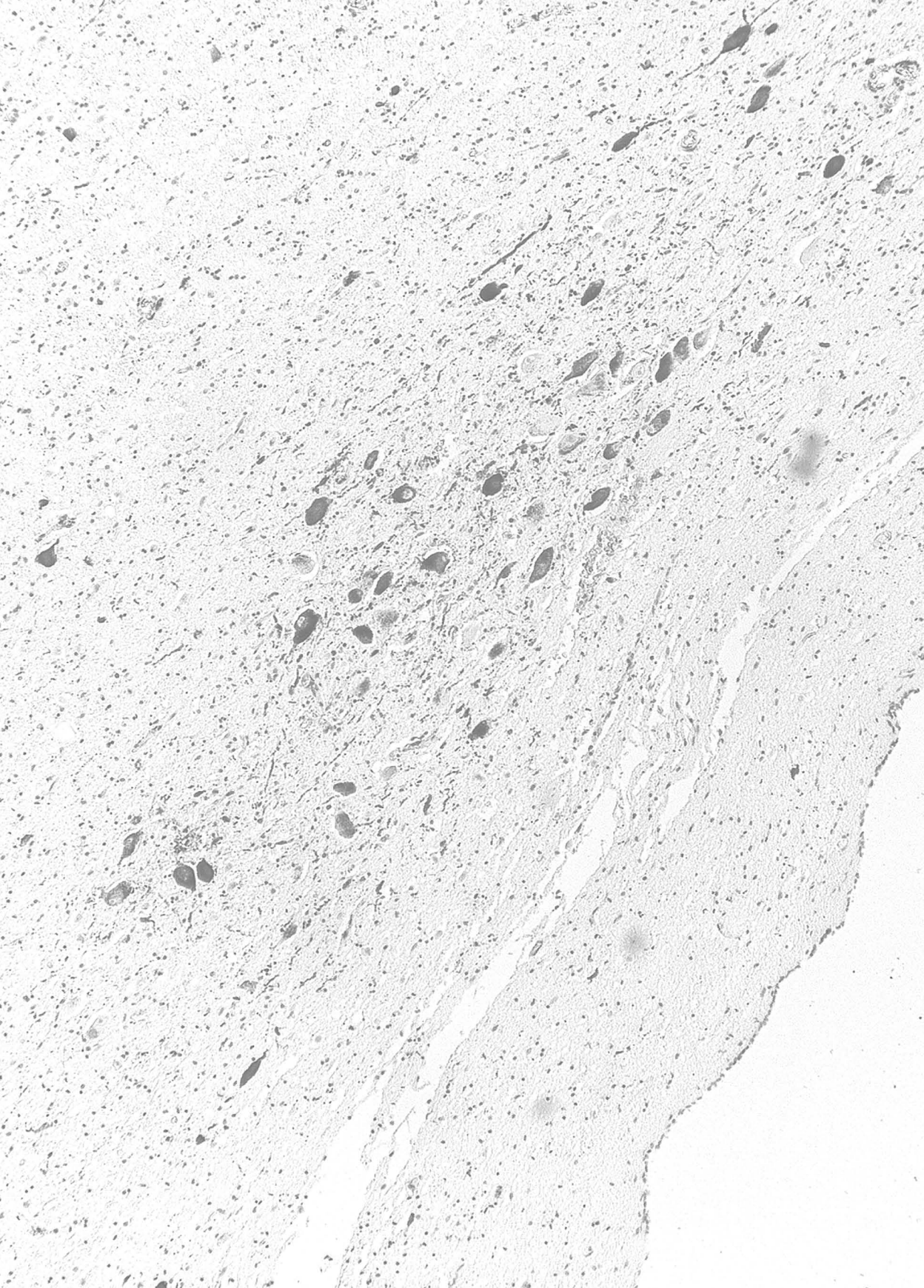
Investigation of the presence and tissue distribution of potential drug targets in human tissue.

Target Characterisation

Assessment of potential urological dysfunction target using human cerebral arteries.

Schering-Plough Biopharma

Analysis of novel proteins and RNA expression in multiple sclerosis.



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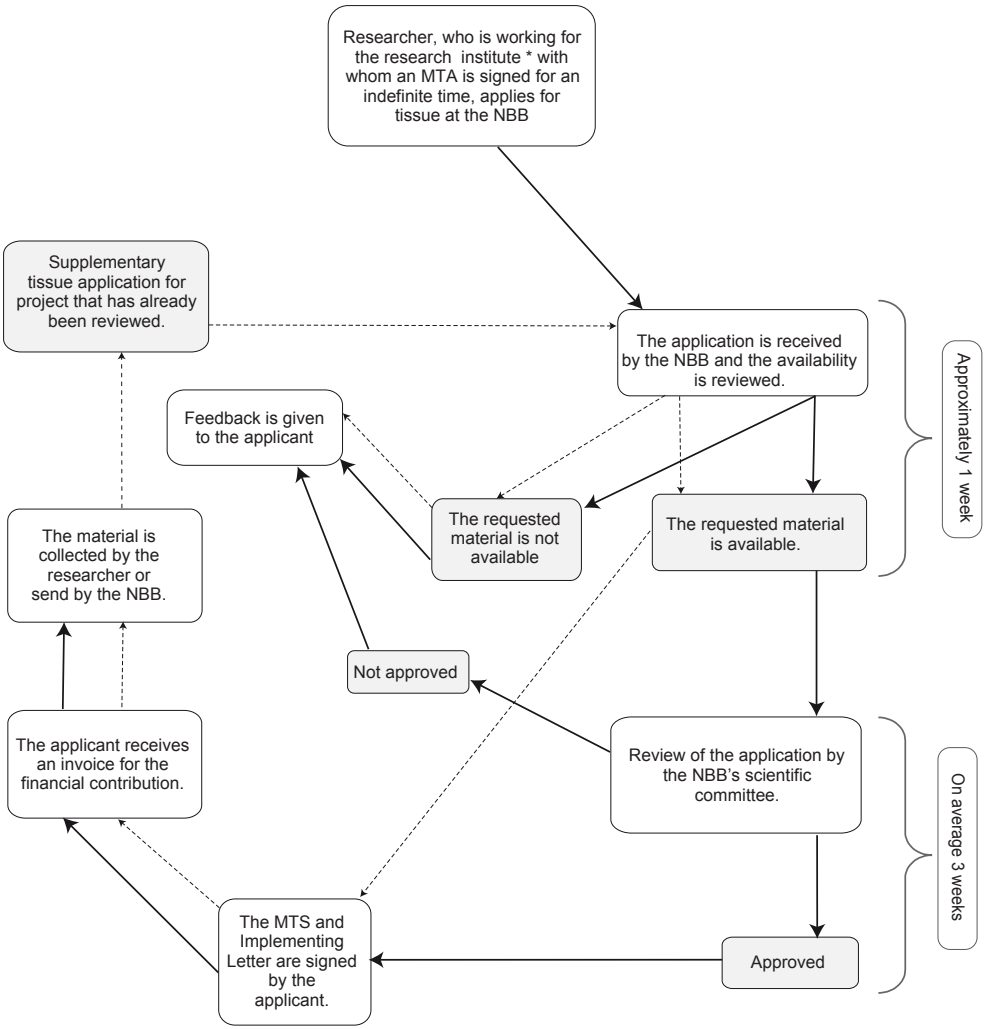
Appendix

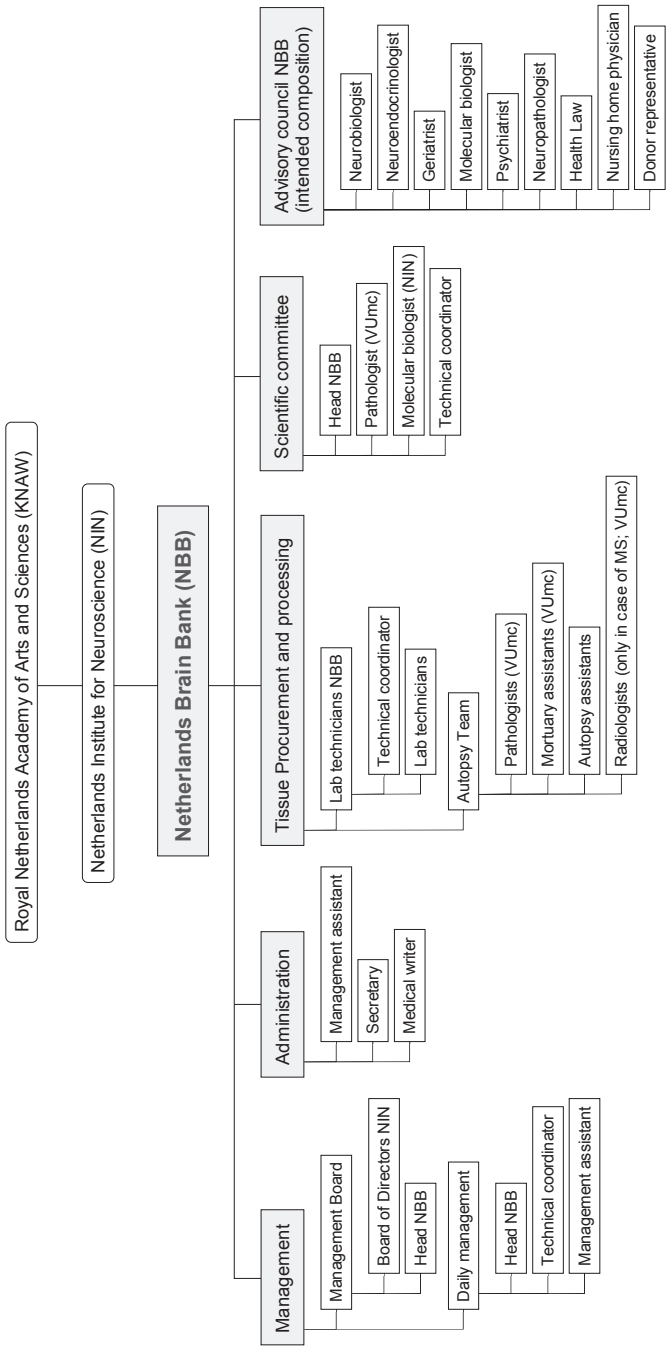
Figure 8 NBB's Procedure of Material Transfer



* The research institute is a legal entity with whom the MTA is signed. Legally, the research institute is thus a party of the agreement. The research institute is thus called "Recipient" of the Material in the MTA and *not* the researcher.
In case no MTA for indefinite time has been signed at the institute/organisation where the researcher is working, the NBB will not supply any tissue. First, the authorized person (head manager or managing coordinator) needs to sign the MTA.

——— Application new project:
- - - - - - - - - - - - Supplementary application within reviewed project:

Figure 9 Non-hierarchic scheme of the organization of the Netherlands Brain Bank (NBB)



Abbreviations

AD	Alzheimer's disease
Contr	Non-demented controls
FTLD/tau	Frontotemporal lobar degeneration/Tauopathy
MS	Multiple sclerosis
Other dem	Other dementia
PANR	Pathological report not ready
PD/DLBD	Parkinson's disease/Diffuse Lewy body dementia
PSP	Progressive supranuclear palsy
Psych	Psychiatric disorders
Rest group	Other diagnoses
Trans	Transsexuality