

Turning the Screw of Immunology<sup>1</sup>  
 Robert Louis Stevenson's  
 "Strange Case of Dr. Jekyll and Mr. Hyde"

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**Prologue: The Red Herring**

Until today the undisputed dominant interpretative approach to Robert Louis Stevenson's "Strange Case of Dr. Jekyll and Mr. Hyde" is psychology. Recent titles like "Stevenson's Unfinished Autopsy of the Other", "Dr. Jekyll and Mr. Hyde: A 'Man's Narrative' of Hysteria and Containment", and "Madness and the Loss of Identity in Nineteenth Century Fiction" show the abundance of secondary literature in this line of interpretation<sup>2</sup>. The interest in psychological or even psychoanalytical aspects of this very "strange" story is grounded in various textual and autobiographically concomitant phenomena. For example, the legend flourishing around the writing process of this story, according to which R.L. Stevenson wrote the story in a kind of hasty frenzy after a delirious dream due to sickness, seems undoubtedly to call for interpretative methods of psychological and dream analysis. What makes Stevenson's description of the act of invention so fascinating is the strange mixture of dream, delirium, and drowsiness on the one side and wakefulness and acuity on the other side which sheds so much doubt on it, as it is offered by Stevenson himself to an interviewer:

All I dreamed about Dr. Jekyll was that one man was being pressed into a cabinet, when he swallowed a drug and changed into another being. I awoke and said at once that I had found the missing link for which I had been looking so long and before I again went to sleep almost every detail of the story, as it stands, was clear to me.<sup>3</sup>

In the *Oxford World's Classics* critical edition, Roger Luckhurst points out

the “dream-like” style and imagery in the “Strange Case of Dr. Jekyll and Mr. Hyde”: “It echoes with the half-remembered sonorous language of the Old Testament. Descriptions have a hallucinatory quality [...] Doubles proliferate everywhere”.<sup>4</sup> The “double” and “Doppelgänger” motif of course link the story as much to the Romantics, Mesmerism, and the Gothic Novel as to later psychoanalytical writings by Freud and Rank.<sup>5</sup> Sigmund Freud analyzes E.T.A. Hoffmann’s “Der Sandmann” as a hallucinatory tale of doubling in his essay “Das Unheimliche”, while Otto Rank offers a surprisingly clear-cut definition of the “Doppelgänger” motif as the psychic splitting of the self, resulting from narcissistic desire, but unavoidably transforming the Doppelgänger into an image of dangerous rival and harbinger of death.<sup>6</sup> Stevenson’s story “Strange Case of Dr. Jekyll and Mr. Hyde” develops exactly along this pattern: Dr. Jekyll is at first deeply attracted to the “novelty”, the incredible sweetness, the youthfulness and “recklessness” of his “alter ego”, only later to find out about his viciousness and relentlessly violent character.<sup>7</sup> Dr. Jekyll’s description of Mr. Hyde also calls to mind Freud’s essay “Das Unbehagen in der Kultur” criticizing the sacrifices of stern civilization: “This familiar that I called out of my own soul, and sent forth alone to do his good pleasure, was a being inherently malign and villainous; his every act and thought centered on self; drinking pleasure with bestial avidity from any degree of torture to another, relentless like a man of stone.” Dr. Jekyll’s self-analysis in the story’s final chapter “Dr. Jekyll’s full statement of the case” – a title that hints at police investigation and forensic defense arguments – mimics these psychoanalytical discourses, which it precedes and anticipates<sup>8</sup>, culminating in the idea of a “second self”<sup>9</sup>:

That man is not truly one, but truly two. I say two, because the state of my own knowledge does not pass beyond that point. Others will follow, others will outstrip me on the same lines; and I hazard the guess that man will be ultimately known for a mere polity of multifarious, incongruous and independent denizens.<sup>10</sup>

Yet this disclosure of the “real” events by Dr. Jekyll himself is postponed to the very end of the story. The story begins with an outsider point of view that

has no knowledge at all of the psychic drama unfolding in Dr. Jekyll's household. The beginning of the story is related by a narrator, oscillating between omniscient and personal perspectives, setting the frame of the story and introducing two characters, Gabriel Utterson, a lawyer by profession, and his interlocutor, Mr. Enfield, who is relating the first incident involving Mr. Hyde. While the main narrator continues the frame story after that, he is abandoned in the last two chapters. The penultimate chapter presents the first-person narration of Dr. Jekyll's close friend, Dr. Lanyon in form of a letter to Mr. Utterson. And the last chapter consists of the confession-like notes of Dr. Jekyll himself with shifting pronouns when referring to Mr. Hyde. The story within the frame story related at the beginning by Mr. Enfield introduces Mr. Hyde, an uncanny, crude, and ugly little man, who is in the course of the frame story connected to two brutal attacks in the streets, one on a little girl, the other a cruel murder of a harmless passer-by at night. The two last chapters of the story reveal what a well-versed reader may already assume: namely that Dr. Jekyll and Mr. Hyde are one and the same person. However, in the course of the story Mr. Hyde becomes stronger and stronger, bigger and bigger, and in the end Dr. Jekyll realizes that he will die one way or the other along with his "alter ego", Mr. Hyde.

The incident that Mr. Enfield is relating hinges on a back door. The two men pass by this door in a small and quiet, yet flourishing by-street in London. The door however, belongs to a building quite different: "a certain sinister block of building thrust forward its gable on the street. It was two storeys high; showed no window, nothing but a door on the lower storey and a blind forehead of discoloured wall on the upper; and bore in every feature, the marks of prolonged and sordid negligence."<sup>11</sup> In the course of the story it is revealed that this door is the back door to Dr. Jekyll's laboratory of which Mr. Enfield is not aware. It turns out that Mr. Hyde possesses the back-door key to Jekyll's laboratory, and can thus enter and leave undetected by anybody else. Such a setting and description of course triggered off psychoanalytic interpretations: not only is this back-door imagery all too readily interpreted as the suppressed unconscious – Mr. Enfield begins his story with asking whether his interlocutor is aware of the existence of the door – but also the description of the building, "a blind forehead", calls to mind the blindness of the conscious (forehead) to its un-

conscious “backyard”. The detail that the back-door key is in the possession of Mr. Hyde, underscores not only the idea that he is represented as the unconscious, but also invites the idea that Mr. Hyde and the back door form the “key” to a correct analysis and interpretation of the “Strange Case of Dr. Jekyll and Mr. Hyde”.

The actual case, however, is quite the opposite: In the story, the back door, or more precisely, Mr. Hyde’s access to the back door, serves as a red herring, as one would say in criminological terminology: it lures the observer away from the true fact. It underscores the false belief that Jekyll and Hyde are NOT the same person, while indeed they are according to Jekyll’s own interpretation. Stevenson is very conscientious with giving further hints to the effect that this back door is most misleading. The whole episode is in fact presented as the “STORY of the Door”, stressing its fictitiousness and lack of reliability. Furthermore, Stevenson pushes all too obviously the argument even further. He lets the lawyer, Mr. Utterson, who wants to find out the truth of Mr. Hyde, declare “If he be Mr. Hyde, [...] I shall be Mr. Seek”<sup>12</sup>, stretching the argument a little too much that Mr. Hyde is that which is hidden and unconscious, while in the reality of the story the lawyer is creating the object of his investigations according to his own fancy. He is indeed completely unaware of what is really going on. It will be important for the further argument of this paper to consider how the text itself both asserts and discards the psychoanalytical argument, and how Stevenson is offering again and again alternative explanations in order to evade reductive decoding.

### Victorian Concerns

In fact, Mr. Utterson and Mr. Enfield are quite misled in their eloquent inquiries into the connection of Hyde and Jekyll. They assume a criminal case of black mail and misname the door and its meaning: “Black Mail House is what I call that place with the door, in consequence.”<sup>13</sup> Tactfully, they leave out any further discussion on the exquisite topic: According to Luckhurst, blackmailing of gentlemen for so-called mistakes made in their youth or for unduly behavior was rampant in Victorian England of the late 19<sup>th</sup> century. It could involve acts of prostitution,

homosexuality, or illegitimate off-spring. Any of these could be imagined as origin of the strange relationship between Hyde and Jekyll by the two characters in the story as well as by the contemporary readers of the text.<sup>14</sup>

Luckhurst mentions the historical murders by "Jack, the Ripper", although the story predates them, as an example of the heightened hysteria concerning crime in London of the 1880s.<sup>15</sup> The 19<sup>th</sup> century witnessed the high rise of criminological investigations by New Scotland Yard as a reaction to the heightened awareness of "criminal behavior" both individual and collective: The advancing individualism of the age had a dark, anarchic side that few contemporaries failed to sense.<sup>16</sup> Restrictions on human desires were slowly lifted and ideas to experiment with and exploit human will power became more wide spread (cf. Darwinism, psychology, parapsychology and so on) . Traditional structures of authority were being challenged in order to do away with limitations on individual freedom. One group especially targeted was the rapidly growing youth population everywhere in Europe. The adolescent was basically considered a state of disease in individual human development which needed constant regulation and protection. The question of control became imminent:

Victorian criminal policy was molded in the midst of these developments. Images of the criminal reflected rising anxieties about impulses and will out of control; crime was a central metaphor of disorder and loss of control in all spheres of life. Criminal and penal policy articulated the effort to counter this perception by fostering disciplined behavior and a broad ethos of respectability. As the brutality of the law was lessened, its reach was extended to cover more persons and more forms of behavior. Vagrants, drunkards, and other "immoral" and "disorderly" persons, on the one hand, and white-collar offenders, on the other, were brought more fully under the purview of criminal policy. [...]

Underlying early Victorian reform of criminal policy was the supposition that the most urgent need, and possibility, of the age was to make people self-governing and that the way to do this was to hold them, sternly and unblinkingly, responsible for the consequences of their actions.<sup>17</sup>

As far as contemporary criminology is concerned, the character of Mr. Hyde is molded according to the dominant ideas and beliefs concerning the origins of criminal behavior: His crude and primitive appearance follows the outdated theory of the once so influential Cesare Lombroso<sup>18</sup> to an extent that may be considered ironical. His youthfulness reflects the obsessive concern the Victorian era had for the growing adolescent population. Hyde's irresponsible and excessive behavior reflects the contemporary Victorian idea that crime is due to loss of control. Dr. Jekyll, on the contrary, embodies the prototype of civil self-control, responsibility, and respectability. Victorian society would describe his sudden lust for "individual freedom" as ill-nurtured and perverse. It is one of the ironies of this story that the "perpetrator" is a prosperous, highly respectable citizen. The comparison of criminal acts to addictive habits, so popular in the late 19<sup>th</sup> century, is reflected in this story by the ever increasing dosage of the drug Dr. Jekyll needs to administer to himself.<sup>19</sup>

The late 19<sup>th</sup> century is also marked by outstanding advancements in scientific knowledge and the enormous rise in population figures and urbanization processes. These changes also affected another discipline closely linked to the organization of communal life: medicine in the shape of general health care and urban hygiene and specific scientific research displayed a parallel structure to the criminal law in the shape of urban crime prevention and police detection. Prevention was the key idea in the philosophy of state or commonwealth embracing the new and dominant concept of "immunizing" its body members and thus strengthening its own existence. The invention of "immunology" in the 19<sup>th</sup> century, landmarked by the turn from cellular to humoral immunological analysis, needed the results of etiology in order to analyze the self-healing processes of the human body as well as the concoction of antidotes and vaccinations. Both dominant scientific fields, criminology and immunology, used similar approaches and concepts reflecting the overall philosophical and political discussions in their times.

### Immunology – A Positivist Science

As with criminology there had also been sporadic attempts at investigat-

ing and understanding what was later to be called immunology, yet the bulk of thorough immunological investigations belongs to the latter part of the 19<sup>th</sup> century and the beginning of the 20<sup>th</sup>. James Kirkpatrick suggested as early as 1754 that people who had suffered from smallpox kept something in their body which made them immune to reinfection. Yet it was the studies of Louis Pasteur and Robert Koch that led to the rise of modern bacteriology much later in the 1870s and provided for the first time etiological knowledge for infectious diseases. Pasteur announced his success in inducing acquired immunity to fowl cholera and argued his famous depletion theory: that the reintroduction of the same bacteria would invariably lead to no further growth. The theories following Pasteur all agreed on the assumption that active bacterial pathogens encountered passive hosts, so that it was thought that it was the bacteria itself which produced the immunity which led to its own standstill. Ten years after Pasteur's first experimental demonstration of active immunity, the scientific community witnessed a reversion in the understanding of activity and passivity in the conceptualization of immunity. The 1880s and 1890s were dominated by the fight of two camps, cellular immunity proposed by Metchnikoff and the Pasteur Institute in France and humoral immunity championed by Robert Koch and the German institute in Berlin. The two groups had notorious clashes, as seen for example, in the face-to-face debate of Koch and Pasteur at the International Congress of Hygiene in Geneva in 1882. While Metchnikoff focused his research on so-called phagocytes, bacteria digesting cells, Koch countered with fluids that produced immunity without the detour of phagocytes. The final blow to the cellular theory came in 1890 with the discovery of von Behring and Kitasato verifying that immunity to diphtheria and tetanus was due to antibodies against their exotoxins. A demonstration showing that passive transfer of immune serum could protect naïve recipients from diphtheria without any need of cellular elements made the humoralists feel victorious. Von Behring regarded his diphtheria experiment also as a proof against the earlier adaptation theory comparing diseases with prolonged abuse of alcohol, morphine and arsenic. The discovery of humoral antitoxic antibodies in the early 1890s was a stepping stone in the rise of immunological studies which exerted a profound influence on the future development in the following century and opened the way for the prevention or cure of infectious diseases by

passive-transfer serum therapy as we know it today.<sup>20</sup>

It is against this background of heated debates on disease and immunity in the bacteriological and immunological arena, the positivist approach to crime prevention and detection, and Victorian concepts of hygiene, morality, and integrity, that Robert Louis Stevenson wrote a “Strange Case of Dr. Jekyll and Mr. Hyde”.

### Setting the Immunological Stage

Immunological elements are so widespread and obvious in the story of the “Strange Case of Dr. Jekyll and Mr. Hyde” that it is surprising that they have so far not been paid due attention in the interpretations of this famous story. Dr. Jekyll’s house and activities clearly hint at the change in paradigm in scientific endeavor in the 19<sup>th</sup> century:

It was late in the afternoon, when Mr. Utterson found his way to Dr. Jekyll’s door, where he was at once admitted by Poole, and carried down by the kitchen offices and across the yard which had once been a garden, to the building which was indifferently known as the laboratory or the dissecting rooms. The doctor had bought the house from the heirs of a celebrated surgeon; and his own tastes being rather chemical than anatomical, had changed the destination of the block of the bottom of the garden<sup>21</sup>.

Dr. Jekyll is interested in chemical investigations of the human body and of the conditions of life as opposed to the earlier anatomical studies of the human body, aptly described, for example, in Mary Shelley’s *Frankenstein or the Modern Prometheus* (1818). It is a change of paradigm from anatomical surgery and electricity to chemical analysis and toxic concoctions that Stevenson’s story offers to the reader. The ugly and atavistic physiognomy given to the character of Mr. Hyde strongly supports this change in paradigm: While the anatomical discourse is as dependent on appearance as Lombroso’s criminological physiognomy (based on the visual), the new chemo-biological science of immunology has to deal with the hidden, and it can only infer results from invisible causalities (based on the



causality of an etiology of the obscure) . In "The Strange Case of Dr. Jekyll and Mr. Hyde" the outward appearance is indeed completely misleading: the two characters, anatomically so diverse, are indeed one and the same person.

So many passages in this story, Stevenson dedicates to the chemical concoctions and self-experiments of Dr. Jekyll, leaving no doubt about the immunological dimension of his research:

I hesitated long before I put this theory to the test of practice. I knew well that I risked death; for any drug that so potently controlled and shook the very fortress of identity, might by the least scruple of an overdose or at the least inopportunity in the moment of exhibition, utterly blot out that immaterial tabernacle which I looked to it to change. But the temptation of a discovery so singular and profound, at last overcame the suggestions of alarm. I had long since prepared my tincture; I purchased at once, from a firm of wholesale chemists, a large quantity of a particular salt which I knew, from my experiments, to be the last ingredient required; and late one accursed night, I compounded the elements, watched them boil and smoke together in the glass, and when the ebullition had subsided, with a strong glow of courage, drank off the potion.

The most racking pangs succeeded: a grinding in the bones, deadly nausea, and a horror of the spirit that cannot be exceeded at the hour of birth or death. Then these agonies began swiftly to subside, and I came to myself as if out of a great sickness.<sup>22</sup>

"The Strange Case of Dr. Jekyll and Mr. Hyde" gives a detailed and circumspect account of the emerging positivist science of immunology. It captures not only the atmosphere and stakes of the new scientific approach, but also discusses some underlying assumptions, such as the search for the right vaccination and the formulas and theories to base experiments on, the vulnerability of the patient to the inoculated serum, and the idea of inducing a certain less dangerous sickness in order to counteract the deathly disease. The whole story clearly and vividly depicts the clash of bacterial pathogen and infected host as it was envisioned at the times: as a battle about life and death between Mr. Hyde and Dr.

Jekyll. As much as this duel can be read as ethical, religious and psychological metaphors of the fight between Good and Evil or Conscious and Unconscious, the concrete setting in the story is that of immunological self-experimentation, up to the risk of failure, mistake in the choice of salt – an important material experimented on in the late 19<sup>th</sup> century – or the purity of serum and the proper dose. Dr. Jekyll is even forced to continually increase the amount of serum in order to induce the reappearance of his former self, the well-educated, elegant, self-restrained natural scientist. In the end, R. L. Stevenson offers an ironical twist to the doctor's immunological self-experiment. The supplies for his concoction are running out:

My provision of the salt, which had never been renewed since the date of the first experiment, began to run low. I sent out for fresh supply, and mixed the draught; the ebullition followed, and the first change of color, not the second; I drank it, and it was without efficiency. You will learn from Poole how I have had London ransacked; it was in vain; and I am now persuaded that my first supply was impure, and that it was that unknown impurity which lent efficacy to the draught.<sup>23</sup>

This is more than simply a crucial or fatal mistake in the experimental proceedings. The quality of the supply, pure or impure, decides on the meaning of the experiment: was it at all an act of immunization? Or did Dr. Jekyll indeed fall victim to a mere casual intoxication by an unknown substance hostile to the inoculated host? In other words: Had he contaminated himself with “impurity”, and thus poisoned himself, rather than invigorated his immunity as was his intention?

### Resistance to Definition

Immunity is a word of Latin origin: “munis” referring to the civil duties of the average Roman male, while “immunis” meant the exemption from such duties due to higher status. In this vein “immune” means “exempt from duties”, “free of cost”, “not performing one's proper part or duty”, “having no part in”.<sup>24</sup> In this sense “immunity” is still used in political discourse for example for the

jurisdictional status of ambassadors and heads of state, kings etc. The medical meaning of the term has to be traced back to the poem "Pharsalia" by Marcus Annaeus Lucanus (39-65AD) describing the legendary resistance to snakebites of a tribe in Northern Africa, the Psylli, but the concrete medical concept behind the meaning in those times remains obscure. Only in the 1880s and 1890s did the term "immunity" come into use describing the phenomena studied by scientists such as Pasteur, Koch, Metchnikoff, von Behring, Kitasato and others.<sup>25</sup> It seems as if the meaning has undergone a change from the original Roman concept of "exempt from duties" to an idea more like "untouchable". And that is probably the way most lay people today understand its meaning. With the invention of the concept of the "immune system" the earlier Roman concept becomes totally unintelligible. In fact, the scientific term "immunity" reflects the early idea of the 19<sup>th</sup> century that in immunitary scenarios the host is passive, while the bacterial pathogens take all the action. In other words: the attacked victim does not need to defend himself, the pathogen will self-destruct. This was later reversed. In Robert Louis Stevenson's story, too, the "aggressive bacterial pathogen", i.e. Mr. Hyde, is the active part, while the "infected" doctor plays his defensive counterpart up to the point of self-destruction induced by the infection with the pathogen.

Stevenson makes a point of using the concept of "immunity" with respect to Dr. Jekyll's self-experiment, but he offers it only in disguise: The first sensations as Mr. Hyde that Dr. Jekyll describes are as "an unknown but not an innocent freedom", exempted from "the bonds of obligation", and yet "a slave to [his] original evil".<sup>26</sup> "Exempted from the bonds of obligation" is the English translation of the Latin "immunis" and refers here to the freedom from morality and duty that Jekyll experiences as Hyde. Yet Stevenson does not fail to ironically counter this apparent freedom with the servile submission to evil.

The term "immunity" itself appears only once in the story with a very interesting shade of meaning, undermining its general usage. It is from the notes of Dr. Jekyll to Mr. Utterson the lawyer:

I next drew up that will to which you so much objected; so that if anything befell me in the person of Dr. Jekyll, I could enter on that of Edward

Hyde without pecuniary loss. And thus fortified, as I supposed, on every side, I began to profit by the strange immunities of my position.

Men have before hired bravos to transact their crimes, while their own person and reputation sat under shelter. I was the first that ever did so for his pleasure.<sup>27</sup>

Here the “immunity” that Dr. Jekyll is thinking of is the legal term: immunity from police detection. He believes he has the perfect alibi because he is able to live in two distinct bodies. The irony of the story is that immunity, in the medical sense of the word and metaphorically in the moral sense of the Victorian endeavor, will kill him in the end. Thus the very “Strange case of Dr. Jekyll and Mr. Hyde” also runs counter to immunological discursive and structural patterns. What was supposed to set Dr. Jekyll free, turns out to destroy him completely. If the chemical investigations in the story were meant to follow the course and the logic of the immunological research of the late 19<sup>th</sup> century, the motivation and the outcome should have been quite different. Instead of conserving the integrity of his body, Dr. Jekyll destroys not only his corporeal integrity but at an earlier stage also his moral integrity. One almost gets the impression, that Robert Louis Stevenson could have imagined the possibility of failure of the immune system, the disease of autoimmunity, long before the idea of the immune system itself had been established. But the case is far more complicated: Eventually, it all depends on the definition of “self”, “not-self”, or Stevenson’s tricky “second self”.

### Self and Not-Self

For over one hundred years, immunological discourse has designed itself as a scientific endeavor analyzing the conflict-laden, if not to say: warring, relationship of “self” and “other”, or as immunologists prefer to call it “self” and “not-self” – even though many of these scientists were only dealing with the tiniest elements in biology or chemistry, sometimes analyzing nothing more than the phenomena of dye acceptance (Paul Ehrlich) . Yet the bulk of scientific analysis and theorization in the 19<sup>th</sup> century, and certainly the reputation and image of immunology, were linked to research on pandemic diseases – quickly to be imple-

mented in public healthcare.<sup>28</sup> Immunologists were therefore prone to design concepts of self and enemy. This atmosphere of hygienic crusades was likely to promote the imagery of hostile agents opposed to a "self" whose "integrity" and "identity" had to be safeguarded.

This kind of imagery becomes even more problematic once the concept of an "immune system" as a "system that exists to eliminate not-self" is being established. In our days, a typical scientific description of the immune system still goes as follows:

The immune system is a network of organs, tissues and cells that *defends* the body *against attacks* by "*foreign*" bodies such as bacteria, viruses, parasites and fungi that can cause disease. It has an amazing ability to *track down these pathogens* and *target them for destruction*.

The organs of the immune system include the tonsils, spleen and small bean-shaped lymph nodes laced through tiny lymphatic vessels. They all house lymphocytes, small white blood cells that are the immune system's key players. Immune cells often have specialized functions – they can engulf and digest bacteria, for instance, or *kill parasites*. They include "*killer T cells*", which mature in the thymus and attack tumors and virus-infected cells. Some T cells "*remember*" *past foes* and quickly *mount a vicious assault on subsequent encounters*.

Unfortunately, immune systems sometimes *engage in friendly fire*, causing disease by *destroying* healthy human tissues. Other problems arise from suppressed immune systems, which can make people *vulnerable* to diseases such as pneumonia.<sup>29</sup>

The words here italicized show to what extent immune systems are envisioned as military operations, not only in the sense that they defend and attack, they are also metaphorically endowed with willpower (to achieve victory) and human fallibility (engage in friendly fire). The social anthropologist A. David Napier's criticism of the scientific discourse of immunology is directed against such militaristic conceptualizations as well as against the accompanying "hero epic" – a metamorphosis of scientific language into dramatic fiction.<sup>30</sup> Military language

has vastly been used to describe not only reactions and actions in microbiology, but also in Darwinist competition and “fitness” scenarios. Napier’s main criticism, however, goes much deeper and touches the very core of immunological thinking:

Here is a domain of scientific inquiry that by its own definition exists specifically in order better to elucidate the biological influence of “other” on “self”; and though immunology is now a very complex, subtle, and sophisticated science, it is essential to remember that it is, and always has been, a science of “foreign bodies”, one where “self” and “not-self” are specified on the molecular level in the paradigmatic battle between antigen (foreign invader – i.e. *antibody generator* ) and antibody (defender of self – i.e. , *anti-foreign body*) .<sup>31</sup>

The main thrust of David Napier’s criticism of modern immunology is, of course, directed against the limitations or complete absence of philosophical, anthropological, or cross-cultural expertise in the formulations of immunological scenarios. It is those basic questions of these disciplines about “self”, “other”, and “identity” which are grossly and inexcusably neglected by a natural science that prides itself of clarifying the relationship of “self” and “not-self”.

While immunologists are not metaphysicians, one can readily see that this debate hinges on an idea about selfhood that is almost wholly unexamined, or if examined, blissfully uninformed by the diverse ways that philosophers – not to mention other cultural traditions – have constructed what we call “identity”. [...] This lacuna is made glaringly obvious by the degree to which immunology has traditionally hinged on a recognition and elimination of biological difference, by the unsolved problems that self/nonsel models have created, by the discipline’s current attempts to jettison the self/nonsel nomenclature, by the inability of immunologists to define “selfhood” in any novel way – in other words, by a wide array of problems all of which bear the scent of culturally tendentious parochial thinking.<sup>32</sup>

According to Napier, the insistency on a presupposed "integral self" mystifies scientific research where alternative, and explicitly, non-Western perspectives might have ready answers.

Immunology, in its fear of the unselfconscious, is, therefore, no more or no less the victim of post-enlightenment metaphysics than is any other field of inquiry or domain of experience. What distinguishes immunology, though, is its hysteria – that is, the vehemence with which it curiously denies the very metaphorical mechanisms of embodiment while unconsciously reviving a demonology better suited to the Dark Ages. It is immunology's hysterical fear of possession that causes Descartes's enlightened reverse engineering to take its final toll autotoxically on the self.<sup>33</sup>

"Autotoxication" and "autoimmunity", because of their obvious, yet mystified relationship to "identity", are the key words to the crux of immunological phraseology and conceptualizations. Yet the scientists do not seem to find a way around the self/not-self model, except discarding the whole concept of "self" once and for all<sup>34</sup>: According to David Napier, an immunological construction of selfhood that focuses solely on recognition and elimination of difference can neither cure illnesses nor answer appropriately to the manifold ways of biological co-existence. More assimilative models of self are needed. E.g. conceptualizations of the maternal or the fetal are based on assimilative models of selfhood. Napier even mentions the human digestion system without which it is impossible for human selfhood to survive. And even the "humble parasitic worms that once populated the guts of most humans" may have had their share in controlling human autoimmunity by simply engaging the immune system.<sup>35</sup> Robert Louis Stevenson's "Strange Case of Dr. Jekyll and Mr. Hyde" is exactly about this problem: an investigation into definitions of selfhood and discriminative theories of self and not-self. However, it would be quite a mistake to refer Stevenson's idea of a "second self" back to psychoanalysis and to understand it simply as a psychoanalytically informed concept such as "alter ego" and to dismiss immunological discourse altogether. After all, immunology offers more dimensions when it comes to the investigation of self and other (or not-self) than psychoanalysis, a

science heavily dependent on metaphor:

Immunology – precisely because it focuses on that area where “self” and “not-self” become ambiguous – provides our best scientific illustration of the amorphous space of negotiated realities in which the distance between subject and object is not absolute.<sup>36</sup>

### The “Other” Discourse in 19<sup>th</sup> Century Immunology

Yet it would be wrong to condemn immunologists wholesale. Especially at the beginning, in the nineteenth century, when the word “immunology” did not even exist, and when the new scientific field was still like a dark continent, many researchers relied on their vivid imaginations or on what they regarded as God’s design. They were led in their research approaches by the already established neighboring disciplines: botany held its sway over the new research field, especially with its Linnaean nomenclature and specification systems with classification into species, genera, order, and individual:

For Schleiden’s generation, and for Nägeli in his earlier days, specificity had been a botanical problem. For Koch and the older Nägeli, it was a problem of bacteriology. For the next generation, it became a problem of immunology: bacterial species, in the absence of visible, morphological differentiae, might be defined by their reaction with specific antisera.<sup>37</sup>

While the famous Berlin based Robert Koch was in favor of species and specificity as modes of analysis, the Swiss Carl von Nägeli in Munich followed a theory of “continuity and quantitative gradual transition”, partly gained from a rather arbitrary adaptation of Kant’s critical philosophy to the natural sciences and partly from Matthias Schleiden’s research which replaced the concept of well-defined species by one of gradual differences. In his *Gattungen einzelliger Algen*, an investigation oriented along the lines of natural history published in 1848, Nägeli analyzed single cell algae in order to find the essence, the concept of the species. From then on Nägeli was no longer interested in differentiae, but



tried instead to understand the transitions that were supposed to connect different forms of life.

In his work on the fine structure of living matter, for example, he examines the transition between living and nonliving; in his phylogeny he sees a continuous flow of forms passing into each other from an origin at this transition point. His theory of fermentation and his bacteriology are built upon *spezifische quantitative Abstufungen*: species differ from each other only quantitatively, by gradual transitions. Everything is connected to everything else: each of these fields is linked in nature to the others.<sup>38</sup>

In 1856 he added to this a "genetic theory of descent", or "drive to perfection", which can be traced back to the conceptualizations of dynamic natural philosophy by late eighteenth and early nineteenth-century German physiologists, and was compatible with Darwin's theory of natural selection, adding to it an additional mechanism of increasing complexity. Indeed, Darwin may have been influenced by such conceptualizations<sup>39</sup>:

Species develop, increase in complexity, and flow continuously upward. The species itself is an individual composed of other individuals, as a tree is of cells. The species and the genus are as real as the individual, and like individuals, they shade in to each other with no sharp differences. An earlier distinction between the continuity of individuals and the absolute differences between species, genera, and orders has disappeared. All is flowing and changing, species and genera as much as the individuals, which are composed of smaller units, like the higher classes. *Unendlich[e] Theilbarkeit* is true of the whole of nature; and so is continuous change.<sup>40</sup>

In the philosophical foundation of his argument, he follows again Kant, who stipulated that each science is scientific only in proportion to the amount of mathematics involved. Neither human beings nor sciences can conceive of absolute different properties, all difference is understood as relative or quantitative, thereby mathematical. There is no absolute difference in nature. "Nägeli traces continuity

from chemical molecules to crystals, to the parts of the cell and the cell itself, through the plant and the animal kingdom to human consciousness.”<sup>41</sup>

Some twenty years later, Koch’s famous disciple Paul Ehrlich, however, when facing his problem of dye adaptation, chooses wholeheartedly the path of solution that is staked out by diversity and specificity and not by unity and continuity. In his dissertation in 1878 he sports the chemical explanation which demands not only specification of the elements entering the process, but even comes up with a new compound: a double salt. The effect must be chemical specific, Ehrlich declares, because it occurs only between the two salts involved.<sup>42</sup> In spite of the factionalism and sectarianism, the fierce fighting over conceptualizations and philosophies between major groups in the formative years of immunology (e. g. Koch vs. Pasteur and Gruber vs. Ehrlich), the idea of species and specificity, so closely interlinked with the concepts of “self” and “other” and “identity” and “individuality”, would become the prevailing doctrine.

### The Strange Case of Immunology

In view of Paul Ehrlich’s pioneering research it is not surprising that Stevenson chooses a salt as the decisive element of immunological success or failure. The choice of salt and the problem of purity highlight the important role chemical investigation and inorganic matter play in immunological research in the latter half of the 19<sup>th</sup> century and in the attempts at unravelling the meaning of life in philosophical disputes based on these natural sciences. Yet Stevenson goes even further: Dr. Jekyll will refer to his “second self”, Mr. Hyde, the product of this salt, as inorganic matter, too:

[H]e thought of Hyde, for all his energy of life, as of something not only hellish but inorganic. This was the shocking thing; that the slime of the pit seemed to utter cries and voices; that the amorphous dust gesticulated and sinned; that what was dead, and had no shape, should usurp the offices of life.<sup>43</sup>

The idea that chemical matter should be at the heart of living beings must have

sounded like blasphemy or pure lunacy to the ears of the average Victorian. While Stevenson is presenting the argument with a religious twist, using Biblical language and metaphor, he also invokes Nägeli's scientific theory of life as "gradual quantitative transition":

I began to perceive more deeply than it has ever yet been stated, the trembling immateriality, the mist-like transience, of this seemingly so solid body in which we walk attired. Certain agents I found to have the power to shake and to pluck back that fleshly vestment [...]. I will not enter deeply into this scientific branch of my confession.<sup>44</sup>

We will later see where exactly Stevenson positions Dr. Jekyll in the immunological disputes between Paris, Munich, and Berlin, and why. This has of course to do with differentiating definitions of self and not-self, and the idea of the "second self" introduced in the story. Returning to crude immunology, the basic and indispensable feature of any immunitary agent is memory. The guiding concept in immunological discourse posits that there can be no immunity without memory, because only the existence of some kind of memory allows an immunizing agent to recognize a recurrent enemy. And it is indeed "memory" that Dr. Jekyll refers to as the absolutely minimalistic link between him and his second self: "My two natures had memory in common, but all other faculties were most unequally shared between them."<sup>45</sup>

Yet, as we have seen, this basic, rather neutral concept of memory is all too readily transported to more complicated conceptual dimensions of "self" and "not-self" the moment immunity is understood as functioning like a defense system. In Stevenson's story it is not only memory that links the two selves, it is also fear, and most imminently fear of death that guides their actions. Fear, that is anticipation of harm and death, is after all the motivation of every immunitary system. At the beginning, when everything seems to go very smoothly, and Dr. Jekyll is enjoying Mr. Hyde's outings and excesses and participating in them in their shared memories, he considers Mr. Hyde's so completely different anatomical appearance as an insurance for himself, offering him immunity against any police investigation. Yet, when Dr. Jekyll realizes that he may no longer be able

to return to his own appearance of a respectable gentleman, he ensures Mr. Hyde's safety and well-being by making him the heir of his property in case of death as well as disappearance. It seems to be a mutual, caring, immunizing relationship that the two profit from. And this is underscored by the fact that the shifting between selves is brought about by the same chemical substance, no matter whether Jekyll is changing into Hyde, or Hyde into Jekyll.

What puts an end to this mutually profitable co-existence is sheer fear of death. Mr. Hyde, who has been caught red-handed, is forced to hide from the police, and is therefore in desperate need of Dr. Jekyll as a temporary disguise.

His terror of the gallows drove him continually to commit temporary suicide, and return to his subordinate station of a part instead of a person; but he loathed the necessity, he loathed the despondency into which Jekyll was now fallen, and he resented the dislike with which he was himself regarded.<sup>46</sup>

The strange relationship Hyde shares with Jekyll allows him to give up his "self" temporarily; but he only does so in order to ensure his survival in the long run – an immunitary strategy, so to speak. Stevenson depicts him with all his archaic fears as someone who loves and clings to life no matter what.

The fears of Dr. Jekyll on the other hand change: At first, he is driven by the fear of the gallows he will have to share with Hyde should that one be caught – a matter of "vital instinct": "Jekyll was now my refuge; let but Hyde peep out an instant, and the hands of all men would be raised to take and slay him."<sup>47</sup> But then his fear of imminent danger of corporeal death is overtaken by the fear of losing his "self" which he understands as the undisputed sovereignty over his body and mind. Hyde has become the stronger part of the two, and appears naturally whenever Jekyll is tired or sleeping. Jekyll, in turn, has run out of supplies for his concoction to induce his former appearance. He is losing his position as master and sovereign in their relationship. After all, it was he, who controlled the substance. The end is unavoidable, since suicide is out of the question for the respectable doctor:

Half an hour from now, when I shall again and forever reindue that hated

personality, I know how I shall sit shuddering and weeping in my chair, or continue, with the most strained and fearstruck ecstasy of listening, to pace up and down this room (my last earthly refuge) and give ear to every sound of menace. Will Hyde die upon the scaffold? Or will he find the courage to release himself at the last moment? God knows; I am careless; this is my true hour of death, and what is to follow concerns another than myself. Here then, as I lay down the pen and proceed to seal up my confession, I bring the life of that unhappy Henry Jekyll to an end.<sup>48</sup>

The passage shows how important it is for Dr. Jekyll at this point to disassociate himself from Mr. Hyde. This is the first time that Hyde has literally become "another" (than myself) . For Jekyll, losing his self to Hyde is as good as his own corporeal death. In fact, at the end of the story, Jekyll abandons the idea of "my second self" construed earlier. He had begun so earlier in "Henry Jekyll's Full Statement of the Case" – rather more of a selfish attempt at defense and self-justification than an honest confession of sin: "He, I say – I cannot say, I. That child of Hell had nothing human; nothing lived in him but fear and hatred."<sup>49</sup> In truth, hatred is the outstanding characteristic of Jekyll's own feelings for Hyde. From the moment he realizes that he is losing his sovereignty, he is solely occupied by one thought: "the horror of my other self".<sup>50</sup>

In the end, Dr. Jekyll, though set to assert his own self, is giving in on all sides: to Hyde, whom he can no longer fight – and who will have the last word, though not in this story – and to Victorian social convention. Dr. Jekyll's so-called confession is a purely imaginary statement of sovereignty. Like Ehrlich, he chooses species and specificity – that explains his interest in salt. Hyde on the other hand is the embodiment of gradual transition, a protean link between the inorganic and organic, brought into existence by a chemical reaction. Robert Louis Stevenson's "Strange Case of Dr. Jekyll and Mr. Hyde" is more than an illustration of immunological research at the end of the 19<sup>th</sup> century, it is an acute and far-sighted critical discussion of what is really at stake in immunological discourse.

## Epilogue: From Science Fiction to Fictional Science

The story “Strange Case of Dr. Jekyll and Mr. Hyde” that Robert Louis Stevenson wrote in 1885 is generally also regarded as science fiction. This paper has tried to argue to what extent it is an indirect but truly critical assessment of late 19<sup>th</sup> century immunological research, probing underlying theses, concepts, and tenets.<sup>51</sup> In writing the text, Stevenson has transformed contemporary scientific, psychological, philosophical, anthropological and religious discussions on “self” and “other”, “identity” and “sovereignty”, and “specificity” and “transition” into the enigmatic relationship of Dr. Jekyll and Mr. Hyde.

The story was so influential that “Jekyll” and “Hyde” appeared as separate entries in the 1928 edition of *Funk and Wagnalls New Standard Dictionary*. *Webster’s Third New International Dictionary* in 1961 introduced the adjective “Jekyll-and-Hyde” with the meaning of “relating to a person who leads a double life or who has two apparently distinct characters one of which is good and the other evil.”<sup>52</sup> Since 1885, “Jekyll and Hyde” have led quite a protean life in everyday speech and discourse, sometimes hardly resembling the original complicated characters and their intricate relationship.

With its special liking for “hero epics” and dramatization, immunological discourse could be expected to adopt the unequal pair, too. In recent years, Dr. Jekyll and Mr. Hyde have become the new heroes in immunological research:

IFN-  $\gamma$  : The Dr. Jekyll and Mr. Hyde of Immunology? [...]

However, in addition to the pro-inflammatory properties of IFN-  $\gamma$  , additional studies have demonstrated another set of IFN-  $\gamma$  attributes that highlight the dual personality of this cytokine.<sup>53</sup>

Dr. Jekyll or Mr. Hyde? White blood cells with a split personality: macrophages. [...]

Our hypothesis is that the same mechanisms to halt the acute inflammatory response are hijacked by pathogens and cancer cells to evade attack by our immune system.<sup>54</sup>

Prostate Stem Cell Antigen: A Jekyll and Hyde Molecule? [...]

PSCA seems to be a Jekyll and Hyde molecule that plays differential roles, tumor promoting or suppressing, depending on the cellular context.<sup>55</sup>

Rheumatoid Factor: Dr. Jekyll or Mr. Hyde? [...]

There are some clues that these two putative subsets of autoantibodies differ structurally but there is little information bearing on their comparative functional properties.<sup>56</sup>

Can the adoption of "Dr. Jekyll and Mr. Hyde" by immunological discourses in our days be regarded as proof to the clairvoyance Robert Louis Stevenson displayed when inventing his famous text? Or are these cases of misappropriation? Will the categorization in "Dr. Jekyll and Mr. Hyde" lead to new and radically different insights in immunological research or will it just repeat a variation of the "hero epic", infesting scientific discourse with inappropriate and misleading, even harmful effects of dramatization? Would Robert Louis Stevenson ever have expected Dr. Jekyll and Mr. Hyde to wander off from science fiction to the fictional science of hardcore immunology?

### Notes

- 1 This paper is a follow-up on my article: *The Rise of Immunology: Robert Louis Stevenson's "Strange Case of Dr. Jekyll and Mr. Hyde"*, in: *American Literature Society of the University of Tsukuba*, Vol. 24, 2014, pp. 21-30. This research was financed by the Japanese Ministry of Education, Kakenhi, Kiban C, No. : 24520336.
- 2 Cf. e.g.: *Ilaria B. Sborgi: Stevenson's Unfinished Autopsy of the Other*, in: *Richard Amborsini and Richard Dury (eds.) : Robert Louis Stevenson. Writer of Boundaries*. Madison (UP of Wisconsin) 2006. *Jane V. Rago: Dr. Jekyll and Mr. Hyde: A 'Man's Narrative' of Hysteria and Containment*, in: *Ambrosini/Dury (ed.) : Robert Louis Stevenson. Writer of Boundaries*. Madison (UP of Wisconsin) 2006 . *Judy Cornes: Madness and the Loss of Identity in Nineteenth Century Fiction*, Jefferson (McFarland) 2008. For further reading, see: *Anne Stiles: Popular Fiction and Brain Science in the Late Nineteenth Century*, Cambridge (UP) 2012 . *William Veeder and Gordon Hirsh (ed.) : Dr. Jekyll and Mr. Hyde after One Hundred Years*, Chicago (Chicago UP) 1988.
- 3 From an interview with R. L. Stevenson on September 10<sup>th</sup> 1887 cited in: *J. A. Hammond (ed.) , Stevensoniana: An Anecdotal Life and Appreciation of Robert*

- Louis Stevenson. *Edinburgh 1907*, p. 85. See also: Claire Harman: *Robert Louis Stevenson. A Biography*, London (Perennial) 2005.
- 4 Roger Luckhurst (ed.) , *Robert Louis Stevenson. Strange Case of Dr. Jekyll and Mr. Hyde and Other Tales*. Oxford (UP) 2006, p. xii.
  - 5 *Ibid.*, pp. xiv.
  - 6 Cf. Sigmund Freud, *Das Unheimliche*, in: Alexander Mitscherlich (ed.) : *Studienausgabe vol. 4*, Frankfurt (Fischer) 1970. Otto Rank, "Der Doppelgänger. Eine psychoanalytische Studie. Leipzig (Internationaler Psychoanalytischer Verlag) 1925. See also: Sigmund Freud: *Das Unbehagen in der Kultur*, in: Alexander Mitscherlich (ed.) : *Studienausgabe vol. 9*, Frankfurt (Fischer) 1974.
  - 7 Robert Louis Stevenson, "Strange Case of Dr. Jekyll and Mr. Hyde", in: Roger Luckhurst (ed.) , *Robert Louis Stevenson. Strange Case of Dr. Jekyll and Mr. Hyde and Other Tales*. Oxford (UP) 2006, pp. 54.
  - 8 "Strange Case of Dr. Jekyll and Mr. Hyde" was written in the summer of 1885 and published in 1886, a bestseller with 40,000 copies sold in the first six months. Cf. Luckhurst, *op. cit.*, p. xl.
  - 9 Robert Louis Stevenson, *op. cit.*, p 58.
  - 10 *Ibid.*, pp. 52.
  - 11 *Ibid.*, p. 6.
  - 12 *Ibid.*, p. 14.
  - 13 *Ibid.*, p. 8.
  - 14 Cf. the introductory chapter "Wider Contexts: Crime, Sex, Class, and Urbanism in the 1880 s" in Luckhurst, pp. xxiii. Cf. Eve Kossofsky Sedgwick, *Between Men: English Literature and Male Homosexual Desire*, New York (Columbia UP) 1985. Richard J. Walker: *Labyrinths of Deceit. Culture, Modernity, and Identity in the Nineteen Century*, Liverpool (Liverpool UP) 2007.
  - 15 *Ibid.*, p. xxx.
  - 16 Cf. e.g. Colin Wilson, *Written in Blood. A History of Forensic Detection*, Grafton Books (London) 1989. Karen Halttunen, *Murder Most Foul. The Killer and the American Gothic Imagination*, Cambridge (Harvard UP) 1998.
  - 17 Wiener, Martin J. : *Reconstructing the Criminal. Culture, Law, and Policy in England, 1830-1914*, Cambridge (Cambridge UP) 1990, pp. 11.
  - 18 Cf. David A. Jones: *History of Criminology. A Philosophical Perspective*. New York (Greenwood Press) 1986. See also: Colin Wilson: *Written in Blood. A History of Forensic Detection*. London (Grafton Books) 1989 ) . Peter Becker and Richard Wetzell (eds.) : *Criminals and their Scientists. The History of Criminology in International Perspective*, Cambridge (Cambridge UP) 2009. And Richard Wetzell: *Inventing the Criminal. A History of German Criminology 1880-1945*, Chapel Hill (North Carolina Press) 2000.
  - 19 Cf. e.g. Susan Zieger: *Inventing the Addict. Drugs, Race and Sexuality in Nineteenth-century British and American Literature*. Massachusetts (University of Massachusetts) 2008 . Trevor Norton, *Smoking Ears and Screaming Teeth. A Celebration of Scientific Eccentricity and Self-Experimentation*, New York



- (Pegasns Books) 2011. Thomas L. Reed: *The Transforming Draught. Jekyll and Hyde*, Robert Louis Stevenson and the Victorian Alcohol Debate, Jefferson (McFarland) 2006 . Allen McDuffie: *Irreversible Transformations. Robert Louis Stevenson's Dr. Jekyll and Mr. Hyde and Scottish Energy Science*, in: *Representations* 96, 2006, p. 1-20. Richard Amborsini and Richard Dury (eds.) : *Robert Louis Stevenson. Writer of Boundaries*. Madison (UP of Wisconsin) 2006.
- 20 Arthur M. Silverstein: *A History of Immunology*, Amsterdam (Elsevier) 2009<sup>2</sup>, passim.
- 21 Robert Louis Stevenson, *op. cit.*, p. 25.
- 22 *Ibid.*, p. 54.
- 23 *Ibid.*, p. 73.
- 24 Glare, P.G.W.(ed.) : *Oxford Latin Dictionary*, Oxford (Clarendon Press) 2000, pp. 838.
- 25 Silverstein, Arthur M. : *A History of Immunology*, Amsterdam (Elsevier) 2009<sup>2</sup>, p.3. See also: Alfred I. Tauber and Leon Chernyak: *Metchnikoff and the Origins of Immunology. From Metaphor to Theory*. New York (Oxford University Press) 1991.
- 26 Robert Louis Stevenson, *op.cit.*, p. 60.
- 27 Robert Louis Stevenson, *op.cit.*, p. 56.
- 28 On Robert Koch and German Hygienic Politics etc. , cf. Pauline M. H. Mazumdar: *Species and Specificity. An Interpretation of the History of Immunology*. Cambridge (Cambride University Press) 1995, passim.
- 29 Hazel Muir: *Science in Seconds: 200 Key Concepts Explained in an Instant*. London, (Quercus) 2011: p.226; all italics by H. H.
- 30 A. David Napier: *The Age of Immunology: Conceiving a Future in an Alienated World*, Chicago, (Chicago UP. ) 2002, p. 69.
- 31 *Ibid.*, p. 41.
- 32 *Ibid.*, pp. 203.
- 33 *Ibid.*, p. 73.
- 34 *Ibid.*, p. 203.
- 35 *Ibid.*, p. 286.
- 36 *Ibid.*, p. 40.
- 37 Mazumdar, *op. cit*, p.8.
- 38 *Ibid.*, p. 31.
- 39 *Ibid.*, pp. 33.
- 40 *Ibid.*, p. 34.
- 41 *Ibid.*, p. 36.
- 42 *Ibid.*, p. 110.
- 43 Robert Louis Stevenson, *op. cit.*, p. 65.
- 44 *Ibid.*, p. 53.
- 45 *Ibid.*, p. 51.
- 46 *Ibid.*, p. 65.

- 47 Ibid., p. 61.
- 48 Ibid., p. 66.
- 49 Ibid., p. 63.
- 50 Ibid., p. 65.
- 51 Though it is well known that Stevenson was an avid reader on theories of identity, psychology, and anthropology, there is so far no information on his reading concerning immunology. However, Pasteur and Koch were belligerent advocates of their theories, influential in academic and economic circles and well-known in contemporary media.
- 52 Cited in: Barry Menikoff (ed.), *The Complete Stories of Robert Louis Stevenson*. New York (The Modern Library) 2002, p. xxxviii.
- 53 *American Journal of Transplantation* : onlinelibrary. wiley. com/doi/ 10. 1111 / ajt. 12468/full (May, 5<sup>th</sup> 2014) .
- 54 Centre d'Immunologie de Marseille-Luminy: [http://www. ciml. univ-mrs. fr/science/lab-toby-lawrence/home](http://www.ciml.univ-mrs.fr/science/lab-toby-lawrence/home) (May, 5<sup>th</sup> 2014) .
- 55 *Clinical Cancer Research*: [http://clincancerres. aacrjournals. org/content](http://clincancerres.aacrjournals.org/content) (May, 5<sup>th</sup> 2014) .
- 56 A. I. Levinson and J. Martin: Rheumatoid Factor: Dr. Jekyll or Mr. Hyde? In: *British Journal of Rheumatology* 1988; 27, pp. 83-90. [http://www. rheumatology. oxfordjournals. org/content/27/2/83. full. pdf](http://www.rheumatology.oxfordjournals.org/content/27/2/83.full.pdf) (May, 5<sup>th</sup> 2014).