

Working together to eliminate cyanide poisoning, konzo, tropical ataxic neuropathy (TAN) and  
neurolethyrism



# CCDNN

## News

Cassava Cyanide Diseases & Neurolethyrism Network

(ISSN 1838-8817 (Print): ISSN 1838-8825 (Online))

### Issue Number 25, June 2015

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#### ***Lathyrus sativus* L. (grass pea) toxic plant or nutraceutical?**

Grass pea seed can cause motor neuron degeneration when consumed as a staple food during a prolonged period in certain socioeconomic setting and when it is the cheapest food available. Moderate consumption in a healthy diet can have beneficial effects.

In ancient literature of both India and Rome, a crippling ailment is described linked to the overconsumption of certain peas. Also in historical times in Europe, a crippling disease occurred in epidemic proportions during famines and in war-times. This was linked to unbalanced consumption of the drought tolerant grass pea that could be collected by people on the run in drought prone areas in Spain during the civil war and in the 'maquis' of Greece during the second world war.

The highest incidence of this neurolethyrism was in a prisoners of war camp in Vapniarca, Romania during WW2: over 60 % of the inmates were affected, while during well-documented famine-triggered epidemics in Ethiopia, only up to 6% of the population was affected.

In 1964, Rao isolated a novel non-protein amino acid from grass pea seeds:  $\beta$ -N-oxalyl-L- $\alpha$ , $\beta$ -diaminopropionic acid or  $\beta$ -ODAP. This amino acid was found to be neurotoxic in day-old chicks. Since then great progress has been made in the understanding of the molecular etiology of this crippling neurolethyrism, and in the reduction of  $\beta$ -ODAP in the ripe seeds. However, questions remain concerning the etiology, especially why, except in dramatic circumstances and extreme stress of a war-camp, more than 90% of the people remain unaffected. Also, after fifty year of breeding efforts, the ultimate goal of stable  $\beta$ -ODAP free varieties remains elusive.

The epidemiology of neurolethyrism and konzo

revealed several risk factors that are common for both diseases such as: food insufficiency, poverty, a high degree of illiteracy, unbalanced diet for a prolonged period and heavy labor.<sup>1</sup> In those epidemiological surveys, stress was not mentioned and probably not possible to measure under the conditions of the field surveys. However, it can be suggested that during drought and famine, stress is present and it is plausible that stress is higher among the poor illiterates than among the more affluent and better educated. The latter may also take more care with variation in the diet. At the Japanese Nihon University, stress was induced in neonatal rats receiving daily doses of ODAP. The incidence of neurolathyrism-like symptoms was increased 4.5-fold by stress.<sup>2</sup> Stress might thus well play a role in the susceptibility for neurolathyrism, and may have contributed to the extremely high incidence in a WWII camp where stress must have been extreme. It is suggested that stress be considered a risk factor in the susceptibility for neurolathyrism.

Compared with the massive efforts to study the toxicology of  $\beta$ -ODAP and the breeding efforts to develop  $\beta$ -ODAP-free grass pea varieties, little effort has been made to study the protective factors for both neurolathyrism and konzo. From published material and personal contacts, both diseases can be prevented if the diet of grass pea or processed cassava roots is supplemented with sufficient cereals or foodstuffs richer in sulfur containing amino acids or antioxidants such as onion.<sup>3</sup> When sufficient alternative foodstuffs are available, neurolathyrism or konzo do not develop. In urban areas where the availability of food is more varied than in drought-prone subsistence farms, neither neurolathyrism nor konzo epidemics occur.

One may wonder why grass pea, with its reputation of toxicity and of being the food of the very poor, has survived as a food crop since biblical times. The adaptability to extreme environments, especially drought, and its palatability must have played a role. But there might be more reasons than agronomic ones. Bangladeshi farmers who claim to consume one kg of grass pea seed per day also say that this gives them stamina to work in the field (M. Hussain, pers. comm.). The presence of about 1% homoarginine in the seed may be responsible for this stamina supporting effect. Indeed, homoarginine is used in food supplements for athletes and bodybuilders. Homoarginine is an alternative for the protein amino acid arginine as substrate for nitric oxide (NO) synthase. NO is a volatile and short-lived metabolite that functions as a hormone in many physiological activities, including the transfer of nerve signals and vasodilatation that occurs during erection. NO also contributes to oxidative stress. Recent studies indicate that low circulating

homoarginine is a risk factor for stroke and vascular diseases.<sup>4</sup> Whether the regular consumption of grass pea seed can contribute to protection from cardiovascular diseases and hence to longevity needs to be studied urgently.

Seemingly unknown to many researchers is the presence of  $\beta$ -ODAP in the longevity promoting Chinese herb Ginseng (<http://pubchem.ncbi.nlm.nih.gov/compound/2360#section=Top>). Under the name Gencichine it is studied and used for its anti-hemorrhagic property. Because of this property, it is added into commercial toothpastes. After fifty years of studies with ODAP, including its discovery, Rao gave an overview of toxic and beneficial properties of grass pea and launched the idea of calling it a nutraceutical.<sup>5</sup> A remarkable item is the effect on hypoxia. Perhaps there might be a link between this and the long history of grass pea consumption in the highlands of Ethiopia, Nepal and Kashmir.

Studies focusing on positive aspects of grass pea may indirectly help the prevention of neurolathyrism by increasing the economic value of grass pea. The historical hot spot of neurolathyrism in the Indian Rewa district has no recent cases. Gopalan explained this as the effect of the market on people's diet.<sup>6</sup> When rice is cheaper than grass pea, as is now the case, poor people no longer rely on grass pea for their exclusive staple food.

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Fernand Lambein

## Ein Arzt im Lager – A camp physician

*Excerpts of Arthur Kessler's memoirs relating to the epidemic of neurolathyrism in camp Vapniarka, Transnistria*

The memoirs of Dr. Arthur Kessler describe his experiences in Romania and Transnistria (Ukraine) as a deportee and inmate of camp Vapniarka and the dehumanising life of Jews in the Transnistrian ghetto. He frequently mentions the marvellous organisation of internal affairs within camp Vapniarka, referring to it as an "protecting invisible hand". This was a benevolent hand which ensured that human dignity was preserved under the austere circumstances that the inmates were subjected to. Water was scarce, hygiene abominable, leading to infections where unwashed clothing rubbed against skin. The diet consisted of plentiful rations of pea soup which were later identified as grasspea (*Lathyrus sativus*), locally known as Tschina. These had been left behind by the Russian cavalry who used them to feed their horses. Up to 50% grasspea could be tolerated by horses, however, in camp Vapniarka other food was scarce so that grasspea soup (large seeded, thick skinned) became a monotonous diet. Kessler's memoirs and the ensuing neurolathyrism epidemic in this camp have recently been discussed in detail by Garfinkle et al. (2011). They interpret the provision of grasspea by the Romanian camp authorities as a deliberate act of poisoning, since the prison guards did not partake of this diet. Zalkind (1937) describes the use of grasspea as human food and animal feed. Considering that, according to Kessler, the camp commander was of the "useless officer category", ignorance on behalf of the camp authorities about the toxicity of grasspea, a need to save expenditure and availability of more pleasant food for the guards are also plausible reasons for leaving the horse feed for the prisoners.

The grasspea soup was initially relished by the recipients as it provided nourishing meals after 10 days of travel without sufficient food. They even drank the reddish water that the peas had been cooked in. A hydrogen sulfide stench quickly developed around the latrines and as a consequence of flatulence. This suggests that valuable sulfur amino acids, that could have helped to prevent grasspea toxicity from developing, passed in the form of indigestible proteinaceous inhibitors into the hindgut where microbial activity catabolised them.

While there is little evidence for malicious intent regarding the use of grasspea, the camp command showed little interest in improving the conditions, even when it became clear that a lot of inmates showed muscle cramps and walking problems.

The grasspea that they ate came from collective farms (colchoses) that had been cultivating the crop instead of the more demanding soybean. When the Russians left they took or destroyed all the food resources, leaving only the stock feed. The cultivation of grasspea in Russia and Ukraine is relatively recent. Zalkind (1937) dated its cultivation in the Ukraine and lower Volga region back to the 1880s. The crop spread due to its adaptation to harsh conditions and its resistance to pests and diseases. It may have originated from Podolia (Northern Moldavia) or through introduction by German immigrants under the reign of Catherine the Great. Compare this with Milczak et al. 2001 who attribute the introduction of *Lathyrus sativus* to the Podlasie region of Eastern Poland to the Tatars during the 17<sup>th</sup> century.

One feature that strikes me is the indigestion, constant rotten egg stench (loss of sulfur) and urge to defecate at night. The gangrene is also a common occurrence.

Could gangrene be caused by moldy food? There is certainly frequent reference to molds, be it with reference to the last bit of jam or rotten potatoes.

The copious volumes of hydrogen sulfide may have had physiological effects!

While this bleak dietary situation slowly leads to the disaster of the neurolathyrism epidemic, Kessler's memoirs focus on the humanity of interactions inside and outside of the camp. A camp economy and social relations develop. People arrange themselves to the newly found circumstances. Hairdressers find customers immediately, dentist and cook do likewise, as all of them have the essential tools of their trade with them in a small bag.

Kessler stayed with the group of people that he met on the train. They share their resources and form a collective. Others fend for themselves, jealously guarding what little they have. Trade with the outside of the camp develops. New relationships form and old ones are re-established. These help to procure sorely needed goods at a price. Whatever gets traded gets taxed by middlemen.

On p. 32, Kessler writes: "Life in the camp develops with timetable and division of labour. A guiding hand can be felt. It is not us nor any of our acquaintances. But it is there. Each hundred-strong contingent has its meal apportioned. They are all of the same cut, as are the contingent leaders. Section leaders are two advocates, of the indifferent type, but they are advised what to do and say. By whom are they advised? We receive more food, early 200 g bread per head, barley bread with wet straw, real chaff. It is deeply split, it crumbles when cut, has a wide soapy strip at the bottom, but it is nevertheless bread. Then we get a little bit of cheese, all officials who have a function in the camp receive this. We

have two, Moritz the hygienist and myself. We get plenty of cheese, thin, watery white cheese. This contains protein, calcium, calories. The cheese is divided by all, also the bread and food leftovers brought from home. The grub mateship that was established amongst five of us on the train continues and Turri joins as sixth.”

This is the style of the narrative. Everything needs to be improvised. Food is smuggled into the camp. Kessler's group purchases 4kg potatoes, wood for cooking, farmer's oil (vegetable oil), at another time beans, nourishing beans, garnished with roasted onions.

Nothing is wasted. The water in which beans or potatoes were cooked contains valuable salt, calories and vitamins and is therefore utilized.

Eggs, corn meal are also occasionally available through trade. Salt is a precious commodity.

“ The corn meal does not keep well. It gets damp and hot inside the bag that it is kept in. The smell of mould develops. It tastes like naphthalene. It has to be used quickly. Potatoes are available in some variety, white, red and yellow in various shapes and sizes. Peeling small potatoes is wasteful. Cooked unpeeled they taste of earth rather than salt and the broth is unusable. “

p. 35: “The big eaters, Turri and Aufleger, have already allocated more to themselves. Spoons are used to divide the food, which is fine for liquids, but spoons of gruel can vary in quantity”.

“When humans are close together, then a community can develop which becomes more affectionate and solid. This works even under the most primitive conditions with level headed, firm characters and education, provided there is no degradation to most primitive needs (rock bottom situation)”

p. 38: Daily ration of peas 400g per head, 8 heavy bags, are collected each day from the military storehouse.

p. 40: We hate the flies. They fall into our pea buckets in such quantities that we lose several minutes until the several centimeter thick layer of flies is skimmed off, before the bucket is taken inside our room. Luckily they are lightweight and swim on top. While eating they crawl into our mouths, they follow us into the latrine. That tickles and burns. Flies are not as bad as worms, cockroaches etc. but they are simply a nuisance.”

p. 41: We no longer sit outside in the doorframe. We get a hairdresser salon that doesn't charge a fee. The money goes into a common till. The people who go outside the camp for work are not always the same, but they, or at least their official leaders, originate from one group. We send people for work into the local hospital, painters, carpenters, locksmiths, to shovel coal at the railway station. The leaders of these detachments make contact with the

guards, befriend them, bribe them and get some concessions. They make contact with messengers which communities or families from home have sent to us. These swarm around the camp pretending to be state officials, inspection officers, cereal merchants or missionary priests. They bring illegal mail and money, smuggle it into the camp and deliver it. Not to the addressee, but to a particular room. From there we receive, what is considered appropriate, and from the received we give, voluntarily, of course, 10% for the costs incurred.” It is the invisible hand at work, also dubbed the “black hand” by Dr. Moritz, one of Kessler's roommates.

Informants are everywhere. Each room and group in the camp has at least one person who reports to the “executive cell” within the camp.

p. 49-50: There was a system in everything. Without announcements or written proclamations. Each position had the right man, the most reliable, the most useful. Everyone had something to do, work outside the camp, camp duty, workshop, restaurant, wood distribution, parasite control and art work. Musical composition and practice of songs, but no idleness.

“The importance of such occupation is unknown to anyone who hasn't been part of a helpless and hopeless mass. Give everyone the awareness to be doing something useful, approve or praise their actions and morale improves.”

p. 51: Dignity and hope had to be sustained, so everyone got something to do. The point was not re-educate, “ but everyone had to become part of a system that helped all to preserve and survive, because if one is demoralized, this demoralizes those around him as well. In this spirit, life developed in the camp. It developed rapidly, so rapidly that one had to think of a guiding hand.”

p. 59: Kessler is in charge of the infirmary or hospital. He describes the meager means at his disposal for treatment of the sick. Boils on the arms, carbuncles on necks, wound fingers, suppurred finger nails, dirt and pus, the old companions of medieval war were present amongst the waiting patients. Amongst these some newcomers, cases with diarrhea, unbearable flatulence and micturition (urgency to urinate). Instruments are disinfected through brief submersion into a solution of formaldehyde (CH<sub>2</sub>O). Surgery of carbuncles is performed without anesthesia. Medicinal coal (*carbo tileae*) is prepared from linden wood. The old people die first, but also the young begin to die. Initial deaths are due to poor hygiene. A young man develops a boil inside his nose, which swells up, he develops a fever and severe headaches, receives a few sulfonamide tablets, insufficient to halt the progressive infection and dies. The whole camp participates in his funeral, but only 20 are allowed outside to bury him. Everyone wants to carry him to

the gate, so in his simple coffin he is passed on every few steps. The heart wrenching wailing, sobbing and crying even stops the guards from laughing. A few weeks later this young man is pardoned and ordered back to his former work place where his services are urgently needed.

The next one is also young, suffering from ascending necrosis and putrefaction of his legs. His legs blacken, the dark color rises from the toes upwards. Blisters grow on the discolored skin. He is insensitive to a needle piercing the sole of his foot, but suffers agonizingly from pain in the sole of his feet. He battles on but eventually dies from heart arrest.

An expedition to collect herbs gets diverted. There were ample strawberries, blue berries, wild roses outside and even patches of peppermint in the near woods. Accompanied by two armed guards, four men went out to collect these, but the sight of a wild pear tree near the first farm house that came into sight, proved to be too much of a distraction. The collected leaves were discarded in favor of dwarf pears. When the farmer's wife appeared the opportunity arose to trade in a few eggs and to drink some milk. A few token bundles of herbs were brought back to distract from the full backpacks. Later on a few more collecting expeditions provided a few herbs and also a little bit of food. It was enough to provide for the sick. Fortuitously, milfoil (*Alchemilla millefolium*) grew within the compound and could be collected after assurance was received from the guards that they would not shoot when the perimeter fence was approached too closely.

p. 62-63: The previous population of camp inmates had died from epidemic typhus (presumably *Rickettsia prowazekii* transmitted by lice) that had killed hundreds of thousands in the whole area. Louse hygiene was therefore carefully implemented with some improvisation, led by the ingenious and humorous Dr. Moritz. The most obvious hosts of lice were repeatedly targeted. In combination with delousing (scrubbing down, washing of clothes), this also included ironing of the seams in clothing where lice were most likely to hide.

p. 68: The peas arrive. The flies are skimmed off. They are stiff and fall into the bucket by the heap. Everyone has their own system to consume the peas in order to minimize suffering. One takes more fluid, the other only the seeds and passes them through a tin with holes in the bottom. A third spits out the seed coats. In the end everyone is bloated to the same extent and all contribute to the stench of rotten eggs in the air. Then comes the urge to visit the latrine. Some don't make it there in time.

On p. 70-72, Dr Kessler gives an overview of the first disease symptoms. The boils are due to dirt and malnutrition, the feverish intestinal infections

(enteritis) have been brought into the camp by someone and the flies have spread it. The peas make the belly tense, influenza, pneumonia and tuberculosis anyone can get. Many have a chill on the bladder and are running day and night. No wonder after the prolonged sessions outside on ice covered beams of a field latrine. One can observe the naked neighbor's skin chilled blue to understand the causes of disease. Many complain about muscle cramps in calf muscles, but others have cramps in arms, belly, face, have stiffened necks and moan in their sleep. Probably nothing unusual considering that people get muscle pain under normal conditions, so our dirt, malnutrition, lack of warm clothing combined with the cold Russian winter not surprisingly leads to stiff and cramped muscles.

Then one day Dr. Moritz comes and reports an old Ukrainian man with unusual gait. Despite Dr. Moritz' love towards "his" Ukrainians, they are a difficult lot for him. Amongst them are several members of primitive sects, who sit in corners with their wife and children and do not want to know of washing, changing of clothes and delousing.

The Ukrainians included members of the religious Bogomil sect (Benditer, 1995; Shapiro, 2013).

This particular case with the unusual gait was one of the sectarians and he was not interested in medical help. Only when his stamina was dwindling did he allow a doctor near him. He was dirty, unkempt, the body only skin and bone but full of lice, so that "just looking at him caused itching. "Look quickly to avoid contracting lice, they don't have any more room on him to suck blood and we don't want them on us" Dr Moritz said.... The knee and foot reflexes jump upon tapping and bounce, the large toes lift upon stroking the sole of the feet. It is a spastic paraparesis of the legs, treat it as syphilis with iodine and bismuth. He did not recover and died briefly afterwards to follow many others.

A few days later three more cases of spastic paraparesis are noted and then the neuropathism epidemic begins in earnest amongst the Ukrainians and Russians. These had been in the camp before the Romanian prisoners arrived and had eaten grasspea since July. They walk stiffly, circle their legs awkwardly and tire quickly. Leg reflexes are acutely increased, tapping of the Achilles sinew causes the leg jump up, leaving it to twitch for a considerable time afterwards, the reflexes of the large toes show clearly that damage of certain tracts of the spinal cord has occurred. These people, Ukrainians and Russians, arrived 3 months before us in the camp, 30 women are amongst them. They were of diverse origin, from Leningrad, Siberia, nearby Ukraine, prisoners of war and ordinary criminals. Common symptoms are cramps in the calf muscles, bladder irritations and the insecure, staggering gait. They had eaten fodder peas since

July. Our attention and questioning of the locals focussed on this food.“

“On the 20.12.1942 our friend and comrade Solomowicz arrives. He walks uneasily, like the deceased old Ukrainian and the other still living victims. He continuously needs to go to the latrine, day and night. He can't hold his waters, doesn't sleep at night due to painful muscle cramps, he can't use his stiff legs, can't lift them nor spread them, he tries to walk but he staggers and falls. The next day a second and third arrive, then the number of the lame quickly rises above one hundred. The first are affected the most. After 3 days, Solomowicz is unable, even with crutches, to reach the latrine or bucket. His legs are spastic, they cross over when he attempts to walk (scissor gait), the leg reflexes are increased to a maximum, the large toes show reflexes that indicate damage to the pyramidal tracts. He needs care. The others are awkward, walk like ducks, waddle, require a broad track (breitspurig), circling their legs, fall, support themselves at the edge of windows, at tables, at columns, try with a stick and end up as nursing cases on the makeshift beds.”

“The loving Regina takes over the lead as head nurse for the care of the patients, feeding, the voiding of urine, treatment of bedridden skin. She has experience since her husband was severely ill for a long time. All bed platforms are occupied, even with two or three to one place. A night watch is set up to change the bottles and to help and solace the moaning who suffer from muscle cramps. It is clear that we are in the middle of a mysterious epidemic. It is not an infection. Affected are Ukrainians, Russians and Jews from our group, but we heard of no cases amongst the guards or camp command. It must be due to our living conditions because bacteria are everywhere. It can't be the water, since everyone is drinking it, nor can it be the bread. A deficiency disease of this kind is unknown to us. The distinguishing feature that separates us from the others is the fodder pea diet. The lame amongst the Russians and Ukrainians have eaten this diet for some time and they were affected first. Amongst us it is the young, the most voracious eaters, those from prisons and penal camps, who, emaciated, devoured the leftovers, that became the first victims of the epidemic. Amongst the women are less and lighter cases. The longer and more plentiful one eats, the heavier the condition develops. It must be the pea diet. First step is to investigate the peas for contaminants, admixtures, fungal infections due to ergot, indiscriminate additions.”

p. 74: “A few dark seeds are found, plant fibres, small stones, nothing suspicious. From memory there are plant toxins in pulses that cause similar symptoms. Experiments are carried out to attempt their destruction through an extended cooking time

of three hours. This and withdrawal of the diet from the affected does not lead to conclusive results. Those who eight days ago showed grave increases in reflex reactions are now paralyzed. Ergo, the peas themselves are the culprits. They are a peculiar type, larger, irregularly shaped, angular, not our wholesome vegetable pea, *Pisum sativum*. We are eating poison and shall perish from it. Something needs to happen immediately.

What is our situation, how does the rest of the camp fare? Each of the seven physicians takes over the medical examination of a group of 100-200 individuals. Moritz takes the Ukrainians. We ask about and investigate for imperative, frequent urge to urinate, muscle cramps, reflexes and gait disturbance. The results are devastating. More than 70% of all inmates show signs or prognostic symptoms of the disease.

We hold counsel. This time the physicians are part of the committee on the first floor. We explain, summarize and reason about our suspicion with respect to the cause of the alarming situation. We come to an agreement. Annihilation has become a danger (*Es besteht die Gefahr zur Vernichtung*).

We have to put the highest pressure on the camp command, we need to alert the central committee in Bucarest, notify official authorities and warn them of the consequences.

A delegation goes to the commanding officer on duty, Captain Buradescu. We are three physicians and I am elected as spokesman. In a serious manner I describe the desperate situation, hundreds of completely or partially paralyzed lame, helpless, with room temperatures below zero degrees Celsius, without a bed, bag of straw, blankets during the heavy Russian winter, terrible hunger, softened through unpalatable bread and occasional supplements of meat from a fallen horse. I explain to him that we are prisoners in a camp during war time, that we may possibly be destroyed through bombing raids or epidemics, but that it is against international law and the duty of a state to poison us on purpose. There are already 120 completely lame and another 1000 on their way. Cause is the toxic pea food. This diet has to be stopped immediately and another form of nutrition to be introduced.

Medical help, medicines, transfer to hospitals for the most severe cases is immediately necessary. He listens calmly with a pinched face and finally replies briefly “How do you know that we are interested in keeping you alive?” End of conversation.

p. 75: The committee consults and decides to send out into all directions urgent appeals with a description of the situation. Blatantly and with many superlatives a message is formulated about the outbreak of the epidemic, its rapid spread, the paralysis and the demand for immediate rescue. “True and correct, but,” I interject, “these words will

ebb out in a sea of misery, after the winter 1941/1942 with hundreds of thousands of victims, epidemics, mass graves and executions on the other shore of the river Bug. We have to deliberate dry and clear: We urgently need 500 pairs of crutches and 50 carts for the lame. We need Vitamins B and C in large quantities, food, ointments and dressing materials for pressure ulcers and gangrene wounds. If help does not arrive soon then our camp will be depopulated, including well known inmates and only a few cripple shall remain." They see the logic of this simpler message and agree.

The appeals leave through all available direct and indirect channels. Those petitions and telegrams sent to the camp command for dispatch are returned 10 days later via the camp representatives marked with the comment "return" [Zurückzustellen]. Meantime the situation in the camp worsens. In the large hall of the infirmary all makeshift beds are full and even the spaces between them are occupied. It is very cold. Around the small tin ovens sit those in circles who can still move, holding their hands to capture warmth above the heat radiating from the plate, legs jumping in continuous tremor. They support themselves with sticks while walking, fall and try again. Many new features appear. Blister on the toes, at heel and edge of foot, dark blisters which open up and become moist. The feet are pale, cold and insensitive. In some the discoloration has risen to the knee and the toes have become gangrenous. They contract fever, the feet turn blue, wounded and purulent (pus forms). They suffered enormous pain and died from ascending gangrene. Others lost their toes and kept their legs. It was hellish, not a picture to be shown, hundreds of sick, lame, gangrenous legs, incontinence before the bins could be reached, bent postures due to muscle cramps in arms, back, abdomen and legs. In addition, the sad, natural phenomenon of the passing of the old, tuberculosis affected and diabetics who weren't strong enough to cope. The care for a stinking gangrenous wound, the warming up of a cold, bloodless extremity, the bedding of a lame and removal of excrement from his bedstead, were insoluble problems.

Finally there was an inspection from the world outside. On the 16.1.1943 a senior executive officer from the government in Odessa arrived for a routine epidemic typhus inspection. He was shown the sick and lame. He grasped the situation, spoke reasonably humane with us and promised to send a neurologist for competent investigation in the immediate future."

"We continued to fight for the preservation of lifes, instilled the sick with smuggled food, milk in small quantities, bread, corn gruel, dressed their wounds with clean, boiled rags and spoke with them to give courage. Keeping them alive was the priority,

everything else is reversible. From a thin shadow a normal human being can be regenerated. A useful person can be preserved for himself and his family. The majority of the peas returned to the kitchen, no strike, but abstinence to the extreme.

Only towards the end of January did we receive bags of dried fruit and moldy potatoes normally destined for pig feed, instead of the fodder peas. Hunger replaced poison."

"On the 30.1.1943 the neurologist arrived, looked fleetingly at some of the paralyzed, got the impression of a viral infection and demanded samples of liquor, exact tables with personal details, prehistory and examination results. A list of 117 paralyzed with the desired information and four liquor samples were sent on the 4.2.1943, accompanied by a memorandum written by the interned physicians in which they explain that the cause for the epidemic is the toxic fodder pea that had been provided as food, and that, based on epidemiology, spread and course, an infection can be excluded. A sample of the toxic pea was included with the kind request for identification, investigation and return of findings, including advice for counter measures. Letters and appeals left by all available channels to anyone with influence."

"Somewhere our reports reached a functionary who grasped the exceptional nature of the situation, not epidemic typhus, not oedema caused by malnutrition but a curious mass paralysis, which might nevertheless be an epidemic that could affect the larger population and the own troops. That has happened to great generals in the past causing them to abandon their ideals."

"Then, on the 22.2.1943, a proper medical investigation team arrived in the camp, led by the neurologist who had been here earlier, accompanied by a second physician, dressed in the uniform of a captain, together with laboratory assistants, microscope, guinea pigs, mice and sterile containers. A series of patients was neurologically examined, blood and urine samples were taken, the experimental animals were injected with liquor and serum. They took all precautionary measures as on entry to an area with an infectious epidemic, nose ointment, masks, coats and sublimate disinfection (presumably mercuric chloride, HgCl<sub>2</sub>). The conversation with the interned physicians was one-sided. We were the expelled, in the best case inferior humans. After all, we are conversant with the language of physicians and point out with due caution that everything speaks against an infectious cause but for a nutritional fault. We present four cases of symmetrical gangrene for investigation. Again we pass on a sample of fodder peas, an updated list of newly affected patients, a petition to the authorities to provide us with food, vitamins, antidotes, beds, blankets and crutches.

Our comments must have left an impression. The pea samples are taken. The immediate response is dismissive. What knoweth thee of the various forms of myelitis? Haveth thou any idea that the liquor of schizophrenics is toxic when injected into experimental animals? and further similar, somewhat arrogant and dismissive lecturing. It was better to remain silent than to debate. The fact that they had come was already a mighty step in the right direction. They finished their work, put down their masks and coats, packed up their liquor and urine samples for further investigations and left. A report about the results was never received by us.”

“Hunger reigns in the camp. The bad dried fruit is without nutritional and satiation value. The small rotten potatoes, cooked with their peel to avoid waste taste like dirty soil. Forty horses, which are sick or crippled and had been culled from the transport columns were allocated to us. Our veterinary, whom we called horse, assumed the important position to daily select an old and a young horse for slaughter and to supervise the butchering process. He had to keep an eye on hygiene and to consider the sensibilities of our inmate friends. When the horse fell on its back feet, then much blood remained in the cadaver and the soup would be black, leading to many refusals. All parts were used and divided fairly, only the head with its large jaws caused associations, some began to neigh, others were disgusted and we learned to abstain from these bones. That all was too little. There was no money to buy smuggled food, what little there was was given to the sickest. The bread was barley and chaff, it had deep cracks and crumbled when cut. Even from the small ration the soldier stole and sold to us for money. Sometimes the veterinarian would approach me mysteriously and slip a piece of liver into my mouth. Eaten raw it suffused one with a feeling of increased strength and persistence. It was pretty difficult to remain on ones feet, but discipline somehow came from above and was preserved under even the most bleak circumstances.

Once a church representative visited. We were instructed to clean ourselves and to expect an inspection by an ecclesiastical functionary. Around 11 am we all stood in line on both sides. Again it was deliberated on the first floor, who would speak, what to say, which petitions were to be presented, and again I tried to subdue with success. No talk, no petitions, only silent demonstration. We all stand quiet, supported by crutches and sticks, all the sick who can barely walk, let him pass and following a signal they all lift their supports off the ground. He entered among the rows, according to his garment a senior catholic priest, waved clemently with benevolent facial expression to the right and to the left, and suddenly there began the collective fall and entanglement of the many people who had held

their sticks and crutches head high; a cruel scene. He retreated, looked around, covered his eyes with his hand and walked briskly through a path that had been kept free by the guards towards the exit. We also never heard from him again.

Meanwhile it was March, the days got longer, occasional hours of sunshine, fewer new cases of paralysis and a slight thawing of stiffened limbs. There even were some who, relieved from cold stiffness, left their beds and limped around. The high point of the epidemic had obviously passed. Only the first, the most severe, remained stiff and immobile. Every little bit of progress was greeted with enthusiasm, discussed and instilled courage in others. The depressing mood cleared up a little, one could hear more cheerful words. People started dreaming again, of commissions, prospects for liberation of the innocently incarcerated. Medical supplies arrived from home. Two Transsylvanian communities distinguished themselves. We received vitamin preparations, ampules of calcium, medicines for pain relief and vascular dilation. Symbolically or real, the feeling that something was happening, had a calming effect. Only the nutritional situation remained a problem. The peas contained caloric value and a poison, the reject potatoes and the bread were unpalatable and the 50 g dried fruit per head were without value. Hunger reigned in the camp.

However, the camp administration now shows an interest for the infirm. Even the regional commander visits the infirmary, permits the erection of beds, donates to us in intervals three times a wether, that is 20 kg of sheep meat for the sick and redirects to the infirmary several times butter, onions and flour that had been confiscated at the gate. That is all that officials make happen. Self-help is active. Two communities, Arad and Temesvar, send plenty of valuable food, also blankets, padding, clothes, and some of it reaches us and provides tangible relief.

Isolated cases of paralysis continue to appear for admission and care. They recruit themselves from the group of infirm who earlier suffered much from bladder problems and muscle cramps. New cases from previously completely healthy individuals no longer occur, proof for the peas as the cause. Among the late cases are relatively more women.”

“ Dark blisters at toes, edge of foot and heel, blue-violet discoloration of the feet, insensitivity of the toes continue to newly appear despite the improved climatic conditions. The spread of gangrene in the legs of surviving early cases is confined and necrotic toes or parts thereof fall off gradually.

In March 1943 also came the insight. A Russian, formerly an agronomist, knows about the pea. He calls it Tschina in his language. It was given to pigs together with barley, bran and corn, mixed as a feed. People didn't eat it. Even pigs and horses



tolerated it in a mixture only up to 50%. The fodder pea was planted in the region instead of the more demanding soybean, because it grows on any soil and it is resistant to parasites. After departure of the army, large quantities were left behind in the collective farms (colchoses), whereas valuable food was taken or destroyed. That was the source of our food.”

“ Then arrived as a result of our reports to the outside world through a physician and friend a copy of an article from the thirteen volume handbook of neurology (1936). The author Privy Councilor Schlesinger, reviews comprehensively reports from Hippocrates until the second half of the 19<sup>th</sup> century, the experiments with man and beast, the experiences in Algerian villages (Kabylia), where all men slide around on their knees, in Algeria where all with paralysis also contracted spontaneous gangrene, the famine years in India and last in Russia, in Saratow, towards the end of the last century. Hunger and neurolethyrism always went together. In our century there was no epidemic of these proportions. The disease symptoms, the dependence on the quantities of seed consumed, the duration of ingestion and the lowering of resistance through hunger and cold, the initial signs as muscle cramps in all parts of the body and disturbance of bladder function, the symmetrical gangrene of the legs and finally the terminal condition of a severe and irreversible paralysis, all agree with the published account.”

“In March finally the long dreamt of politico-judicial committee from back home with representatives of the secret police, the interior ministry and the senior court martial. On the first day these non-physicians are presented with dramatic impact on a series of paralyzed cripples with gangrenous legs. The impression is smashing. They demand and receive a list of six hundred infirm, one hundred and forty completely paralyzed and fifteen disfigured by gangrene. They take petitions for the responsible police authorities, for the Jewish central committee to provide carts, beds, dressing materials, food, medicines and promise to pass these on. They receive deputations in the presence of the camp and local commanders and even allow us physicians to participate. The sick feel that a change has happened, that something is in motion and are grateful to us physicians. Afterwards they appear to express their gratitude and present us with hand-made small symbolic presents carved from plates and drawings [see Hirsch and Spitzer, 2006a for illustrations]. The committee stayed for three days. We learned that documents were being examined and consultations took place. Wishful thinking and hope dispelled apathy; hunger, thirst and pain were easier to bear. We heard of lists, of groups, of liberations. Then they departed and left us in a

doubtful mood. Who is going to be part of it? Who shall be free. Shall we be able to return to our families?

The severe winter was over, April gave more warmth and some rain, and during Mai the order came. A few hundred of us, divided into three groups, are to leave camp Vapniarka and our destination is the ghetto of Oligopol. We take paralyzed people with us, but on average less than we are entitled to, because those who had been in work camps and prisons became afflicted to a much larger extent, and even those were retained in the camp.”

The 80 pages of the memoirs that follow describe the horrific and degrading life in the Transnistrian ghetto. Kessler remains resourceful and is able to set up a facility to care for the sick, using basic means. He also begins to trade with the local farmers, exchanging his medical services, self-made soap and tinctures extracted from medicinal plants for food and other essentials. In comparison to what is described about the well-organized life in camp Vapniarka, the ghetto is worse as it dehumanizes the individual. In these memoirs Kessler also refers to a diary that he must have used to write his memoirs. Perhaps these are the scribbled notes that Shapiro (2013) refers to in his excellent piece of sleuthing and informative account, which should be read in conjunction with this translation.

The last section of the narrative about the neurolethyrism epidemic has been translated almost verbatim to provide an English text from one of the key witnesses of the events that occurred. This allows further cross referencing and fact checking with other witness accounts. Incidentally, there is another yet unpublished translation of Kessler's memoirs, which, unfortunately was not available for consultation (Hirsch and Spitzer, 2006b).

For example one witness who provides the insider's view of the camp's communist benevolent hand", claims that there had been paralyzed and crippled inmates prior to the arrival of the Jewish group that Kessler belonged to, and that these were allowed to crawl into freedom, only to be shot shortly afterwards (Kornis, 2004).

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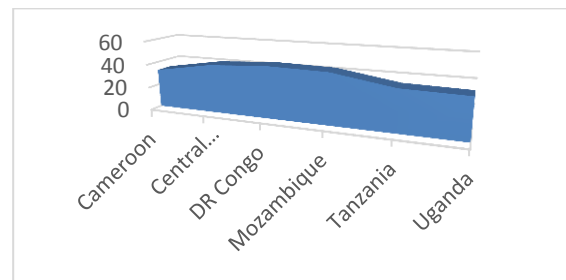
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### 1000 days to prevent stunting among children in the konzo affected areas

The neurodegenerative disease «konzo» which is a toxicological, nutritional and neurological disease, is encountered in central and south- eastern parts of Africa. Konzo cases were reported in the remote rural areas of DR Congo, Cameroon, Central African Republic, Uganda, Mozambique and Tanzania.

The flour obtained from bitter cassava roots (*Manihot esculenta*) is the staple food of the affected population. Bitter Cassava roots contain cyanogenic compounds which can be eliminated during processing. The process consists of retting cassava cassettes (chips) during at least three nights, then sun-drying at least three days, and finally pounding to obtain flour. High exposure to cyanogenic compound from insufficiently processed bitter cassava roots, as consequence of intensive trade and hunger or famine, has been implicated in the causation of konzo. The disease has been reported to occur during dry (lean) season or after or military action when food becomes scarce.

**Figure 1: Prevalence of under-5 Stunting (%) in konzo affected countries (source: Global nutrition report 2014: country profiles)**



Konzo is associated with monotonous diets based on cassava roots and leaves; the main dishes are composed by porridge (fufu, gozo, ugali) obtained from processed cassava flour and by vegetables, especially pounded cassava leaves.

The disease is characterized by spastic paraparesis or tetraparesis that affected mainly women at childbearing age and children above two years old. No konzo case has been reported to affect children less than two years old. Children less than one year cannot yet walk properly and breastfeeding might play a big role in child protection during the early childhood age. But children in those konzo affected areas are experiencing low-birthweight<sup>1</sup> and stunting<sup>2</sup>.

Poor maternal nutrition contributes to low birthweight, subsequent stunting and other forms of undernutrition. Undernourished girls have a greater likelihood of becoming undernourished mothers who in turn have a greater chance of giving birth to low birthweight babies, perpetuating an intergenerational cycle. (Unicef, nutrition report, 2013).

After birth, a number of practices can directly lead to poor growth: inadequate breastfeeding practices such as non-exclusive breastfeeding; inappropriate complementary feeding, such as starting at the wrong age; poor access to or use of diverse types of food and inadequate intake of micronutrients.

Poor nutrition in the first 1,000 days of children's lives (covering pregnancy and the child's first two years) can have irreversible consequences:

- Low birthweight is associated with increased morbidity and mortality; One of the major challenges in measuring incidence of low birthweight is the fact that,

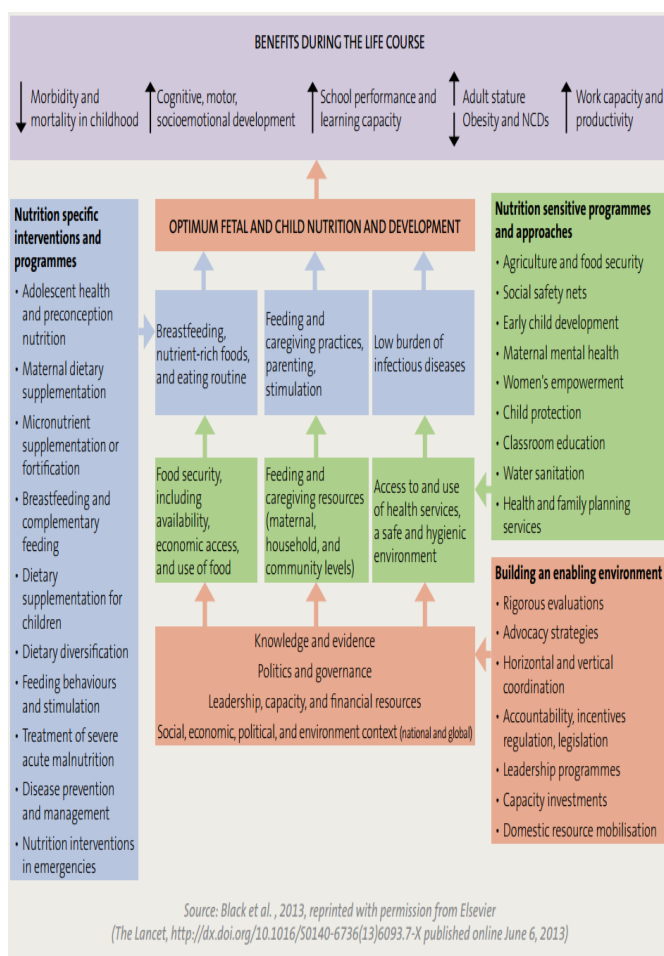
<sup>1</sup> Low birthweight is defined as a weight of less than 2,500 grams at birth.

<sup>2</sup> Stunting reflects chronic undernutrition during the most critical periods of growth and development in early life. It is defined as the percentage of children aged 0 to 59 months whose height for age is below minus two standard deviations (moderate and severe stunting) and minus three standard deviations (severe stunting) from the median of the WHO Child Growth Standards.

as of 2011, more than half of the world's children had not been weighed at birth

- Stunting and other forms of undernutrition are clearly a major contributing factor to child mortality, disease and disability. High prevalence of stunting is predominant in the konzo settings; around 40 percent of children less than five years old are stunted (see figure 1). Stunted children are more susceptible to sickness.

**Figure 2: Actions needed to address child malnutrition**



Critical nutrition interventions that break this cycle include promoting optimal breastfeeding practices, encouraging micronutrient supplementation and reducing the incidence of low birthweight.

Nutrition-specific interventions are actions that have a direct impact on the prevention and treatment of undernutrition, in particular during the 1,000 days. For addressing the immediate, underlying and basic causes of malnutrition, effective nutrition-specific interventions, including community-based programs, implemented at scale, are required. These interventions should be complemented by broader,

nutrition-sensitive approaches that have an indirect impact on nutrition status across a broad front – from health and health system strengthening, to agriculture and food system strengthening, education, water and sanitation, gender, social protection, trade, employment and labour policies, and poverty reduction. There is also increasing awareness of the need to ensure that the environmental impact of nutrition interventions is assessed. Figure 2 provides a graphic representation of needed nutrition-specific interventions and nutrition-sensitive programs and approaches to address childhood malnutrition (Black et al., 2013).

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### Konzo and Prevention in Mozambique

*SPECIAL SYMPOSIUM ON KONZO: RECENT ADVANCES, INNOVATIONS AND CIVIC ENGAGEMENT; Kinshasa, Democratic Republic of Congo, 5th September, 2014*

Konzo in Mozambique has presented in both epidemic and endemic forms. Three large epidemics have been reported, with the first in 1981 during a severe drought in northern Nampula Province. In that epidemic, over 1100 cases were recorded. The second, in 1992-3, occurred further south in the same province, with over 600 cases associated with war. The third, in 2005, affected the central province of Zambezia, and was associated with drought and increased trade. Over 100 cases were reported. Smaller epidemics and sporadic cases have been reported in both provinces, and konzo is now persistent in Nampula. The geographical range has extended, with cases reported from more districts in the decade 2000-2009 than in the decade 1980-89. Healthy schoolchildren in konzo affected areas have high urinary thiocyanate concentrations, and post-

epidemic studies have shown that 4-22% have ankle clonus. Recent prevention efforts in Mozambique have focused on introduction of the wetting method to reduce cyanide concentrations in cassava flour. Three konzo-affected village sites were chosen for an intervention, with monitoring of cyanogen concentrations in cassava flour in households and urinary thiocyanate concentrations in healthy schoolchildren. Falls in these concentrations have been recorded in the intervention sites. Future concerns include the possibility of further epidemics, particularly in droughts, as unequal development increases rural poverty, and climate change impacts. The long-term impact of the chronic cyanide intoxication recorded in konzo-affected populations is also of concern. Solutions include agricultural development which supports these poor rural cassava-dependent areas, a diversification of the diet, and introduction of better processing techniques, such as the wetting method.

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