How the Germans Achieved Success: Thought Process and Development Plan

In the last 10 years or so German cross-country skiers have clearly improved faster as a group than most of their counterparts in other nations. Three different German men have won the World Cup three years running, and the women have been in the medals in World Championships and Olympics (particularly the relays). Such predictable strength in their team must reflect the fundamental wisdom of the their program.

What are the origins of such success? What sort of thought process brought it into being? What are the various elements of training development which seem to work so well? Americans can reflect productively upon the answers to these questions, in particular because the problems the Germans identified in the 90's seem still descriptive of our nordic ski situation today.

Luckily, the Germans published their refelctions in some detail. First, was a pamphlet Tim Gibbons passed along to me entitled *Information/Dokumentation Sport* published by the Intitute für Angewandte Trainingswissenschaft (Institute for Applied Training Science) in Leipzig. Georg Neumann, the dean of German endurance science, and Anneliese Berbalk review the thought process behind "Development Tendencies of the Training and Compeition Systems in the Endurance Sports with Consequences for the Olympic Preparation Cycle 1996-2000." I excerpt broadly, translating from their report, and intersperse the resulting planning charts presented in *Das Grosse Buch vom Skilanglauf* by Hottenrott and Urban, with significant additional section by Neumann and Ostrowski. My own comments appear in italics.

The development of endurance performance in Germany has no longer kept up with the international trends in some sports. Single successes should not delude us into thinking that fundamental inadequacies do not exist in the long-term performance buildup. Independent of that, performances are not brought to a peak in meetings with international competition. The quota of scores for bringing individual best performance to a peak is sinking. Beyond that, performance levels among juniors are carried over into the senior(elite) levels with too much attrition. These observations from the sports medicine perspective are the impulse to point out some physiological factors in the development of endurance capabilities. In practice there are also positive examples that national and international success occur with the consequential application of fundamental methodical sports knowledge. Using triathlon as an example, the influences of sports-specific knowledge upon the development of performance is presented from the perspective of sports medicine which can be viewed as having general validity. In triathlon the multi-sport concept, for which there were no examples, had to be converted. The experience of swimming, distance running and biking were put together.

Analyses of previous performance development in triathlon show that the essential elements of individual and team performance success were the use of factors of training volume and training course of about a hundred day a year. In a period of four years the strongest athletes have succeeded in almost doubling the total training load. Whereas in 1991 the total load for men lay between 600-800 hours, at present it lies between 1200-1600. With the achievement of the high total loading came new adaptation problems, to be sure, which lead to the formation of a performance structure which was not totally foreseen.

Ostrowski

Numbers around which long-term performance buildup Is oriented

	General early trng.	Youth Development Basic	Buildup	Transition	High Performance
Weeks of training	40	44	46	48	50
Total year volume (hr)	-200	200-400	400-900	900-1200	1200-1500
Sessions per week	1-2	2-4	4-6	6-10	10-14
Hrs/week special trng.	2-4	3-8	6-12	12-20	20-30
Distance (km)	many sided trng.		1200-4000	4000-7000	7000-10000

(Cf. Athlete reports as end of article)

Successful training concepts presume a high correspondence between loading demands, load capacity and processing of stimuli. Every development in performance is connected to a higher level of adaptation of the aerobic and aerobic-anaerobic performance bases, in accordance with the demands of the performance structure. Without having reached specific standard quantities in the maximal oxygen uptake, the energy flow appropriate to the demands for elite performances is not possible. The maximal O2 uptake for the world's best male endurance athletes is 80-87 ml/kg/min; for women 68-75 ml/kg/min. These values are attained only too sporadically in triathlon and above all not in all deisciplines (run, bike). If an insufficient aerobic base performance must be compensated for through an additional or premature switch-over to anaerobic metabolism. The attainment of a high maximal O2 uptake in March is also of limited aftereffect, if the performance peak is needed in August. The formation of 1 mmol/l of lactate can replace the lack of 2.7 ml/kg of O2 momentarily and [only] for a short time.

Period	Month	Week	Duration
Preparation period I	Mai-Juni	18-27	10 Wo.
Preparation period II	Jul-Sep.	28-37	10 Wo.
Preparation period III	Okt.-Nov.	38-45	8 Wo.
Competition	Dez-März	46-13	20 Wo.
Transition	April	14-17	4 Wo.

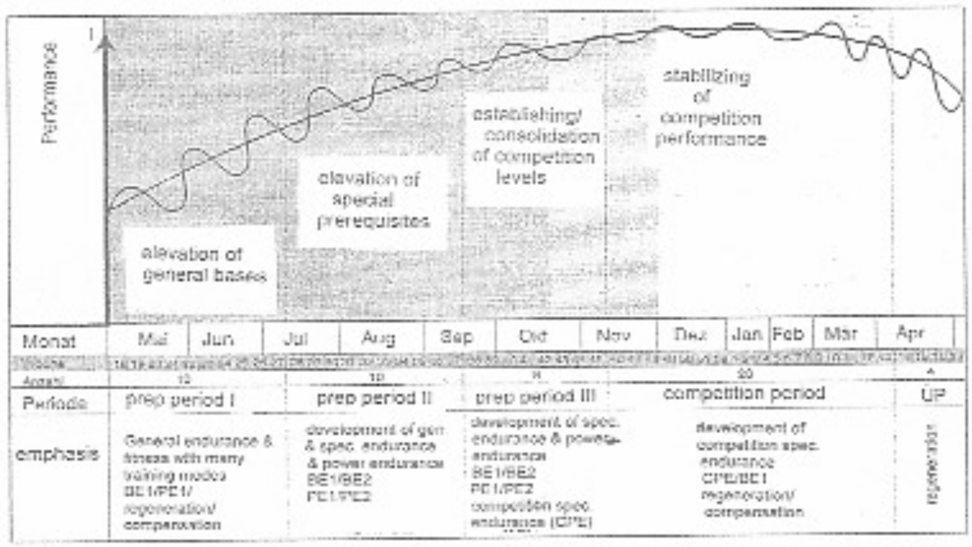

Abb. 10.10: Periodisierung im Skilanglauf

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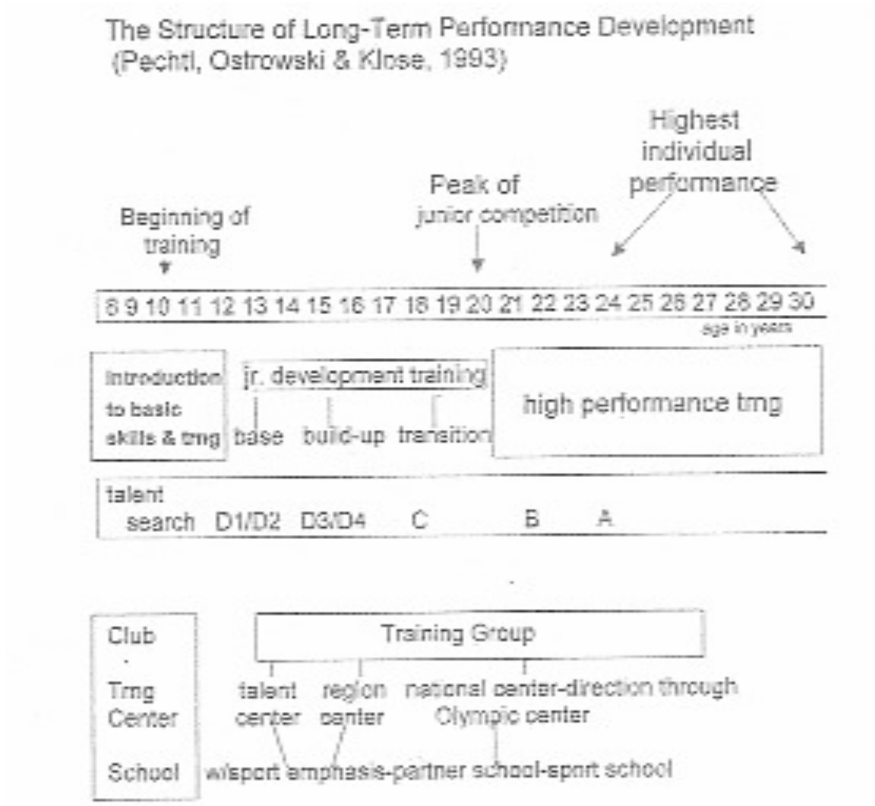
If in the process of training, whether in the course of a year or a sequence of years, there is a counterdevelopment of maximal O2 uptake, then this is always an indication of decreasing aerobic energy flows and can be corrected sport-methodically through corresponding training. At present from the point of view of training methodology attempts are being made to shrink the load volume and allegedly to replce it with more quality (intensity). From the performance-physiological perspective this training principle in high performance sport is damned to failure or produces only unstable higher performances, most not at the desired or expected time in the training year. When the aerobic basis is lacking, the end effect is performance instability and premature performance stagnation, in spite of the "hard" training done. [Emphasizing the need for a year-round mix of training modes and intensities], a maximization of [only] certain performance bases is most often disadvantageous (example: high oxygen uptake but low lactate mobilization or highest mobilization with too small VO2max).

With current top performances in the endurance sports, talented juniors do not accomplish the transition into the senior class seamlessly. Just to equal out the adaptation deficits between junior and senior loading requires planning 2-3 years of training. This time is simply necessary, in order that in accomplishing the high training volume of 30-40 hrs/wk the qualitative factors in training can be affected. In this time the junior who has up to now been successful seldom has athletic success. This problem is critical for leader of young talent, so that they continue in performance sport.



In sum, endurance training, independent of sport type, leads to the following adaptations (table 3.). These empirically substantiated principles ought not to be broken by lack of system or by spontaneity.

Table 3.

Adaptations to Endurance Training

Expansion of typical neuromotor movement program with preferred recruitment of ST-fibers
Contribution of fat metabolism to assure the energy for endurance performance
Enlargement of glycogen and triglycerides in the musculature
Reduction of body fat to 6-12%
Increased active of the key oxidative enzyme in ST-fibers
Heightening of the aerobic energy flow rates and lowering of the anaerobic flow rates (less lactate formation)
Rise in the capacity of the O2 uptake-, transport- and utilization systems (enhancement of VO2max)
Increase in heart size (athlete's heart)
Longer resistance to fatigue in the sport-specifically trained musculature
Rise in the muscular endurance- and power-endurance capacity (higher forward impulse performance)

The Evolution in the Manner of Periodization and Long-Term Development

The most certain way to higher endurance performance capability is to elevate the loading volume in sport-specific training. Since training volume cannot be stored, it must always be organized in a context of competition-specific performance capability. [The German measure each month or so with time trials/ various competitions and/or laboratory testing.] This notion has validity for the endurance athlete and has particular significance for bridging from juniors into the senior class. The possibility to start in many competitions seduces more and more trainers and athletes into ignoring the fundamentals of training method. Every experienced trainer knows that the proven and ultimately successful training procedure are linked to the physiological potentials of individual load-assimilation and the processing of training stimuli. Training is for biological subjects, not for plans.

Between the separate forms of energy mobilization, the aerobic, anaerobic and anaerobic-alactic metabolism here exist relatively fixed relationships in their tolerance and ultization for a specific performance structure. This is mirrored in the proportional dependence of the methodological categories of Base Endurance I (BE I) and BE II(base endurance zone II or development zone), as well as competition-specific endurance. The proportions of intensive training (BE II) and competitions relative to total volume are probably independent of the sport type and are constant. Nevertheless, the proportion of competition loading, related to total volume, can rise, if the race courses are longer. The frequency of starts is fundamentally dependent upon the niveau (level achieved) of the aerobic training. Athletic failures or premature performance decreases have their origin in too little volume training.

The cardinal problem is not the intensive loading by itself, but rather the potential for loading anew after intensive training units or after competitions. A series of races which is too dense furthers the decline of performance capability and stability, since the normal endurance training is replaced by compensation loading/stress. The loading/training effort which follows one race and prepares for the next is seen by the athlete as training, and the inferior quality of inevitably proceeding is is not noticed. Not until after the fourth competition weekend, almost independent of sport type, do signs of the greater strain in competition appear, and the first instability in the intensity work noticed. The main reasons for this phenomenon are lacking or insufficient sport-specific endurance loading stimuli in the aerobic metabolism situation, in corresponding duration and quality. The dwindling aerobic energy flows (decrease in the proportion of fat metabolism in favor of carbohydrate metabolism) must be compensated for by higher and higher anaerobic metabolism. Every form of persisting mixing of competitions and compensation loading is a sure road to producing performance instability and declining performance.

Through the internationalization of training and competition systems the demands on training load are becoming harder, with the tendency that the intensity portion climbs within the same volume. These challenges can only be met through a re-orientation of training on the bases of physiology. In order to maintain the loading volume it can be arranged differently. A proven form is the endurance block done in phases [periodization]. High economization in metabolism is thus addressed and at the same time space created for more intensive training units (table 4).

Table 4.

-Economizing of the functional systems at a low level of function.
-Stabilizing a sport-specific motor stereotype
-Possibility of linking with resistance stimuli (aerobic power-endurance)
-After the basic endurance block neuromotor training in the aerobic-anaerobic transition zone is mostly necessary
-Base endurance block is also memory stimulus for raising sport-specific aerobic performance bases
-Base endurance block is also memory stimulus for reactivating aerobic performance capacity after intensive training (ex. race series)

There is more time for the BE II training, the essential middle loading step towwards competition. These insights are not new. They are not internalized by the younger generation of coaches, or they are suppressed or forgotten. In high performance sport there is no yearlong repetition of recipes for success. While tested principles are maintained, for individuals new combinations and changes in performance buildup must be designed, simply so the organism remains sensitive to training stimuli.

From findings [on Kenyan training] there are no principle notions to be derived for new training concepts. The data do suggest, however, that we re-think the way in which speed work is built into aerobic running training. It is known that the span in neuromotor loading in which it remains possible to run aerobically is greater than assumed and should be correspondingly and methodically used. From the sports medicine point of view the goal could be in the development of abilities which make possible running at higher speeds and in the process to turn over higher contributions of free fatty acids. This state of regulation assures longer use of the glycogen stores and at the same time blocks protein breakdown. Protein catabolism set in later because of glycogen reserves which are useful longer and is thus the precondition for a higher specific loading capacity.

The weak points in endurance training are multi-dimensional and consist from the sports-medical perspective in the too low adaptation (adaptation which results from the suspension of loading) in aerobic energy flow rates during sports-specific loading (Table 5).

Table 5 Weak points in endurance training from the perspective of

performance physiology

Training volumes of <15hrs/wk in high performance training lead to aerobic energy flow rates which are too low and are the main cause of endurance instability.

Highest performances require supercompensation in the structural aerobic power-endurance potential, which then lessens in the competition season.

Corrections for too low or unstable aerobic endurance bases are possible by means of aerobic endurance training lasting 1-2 months.

Endurance training with too high intensity sections (>30%), in the form of aerobic-anaerobic mixed training, leads to premature organization of performance – but at too low a level.

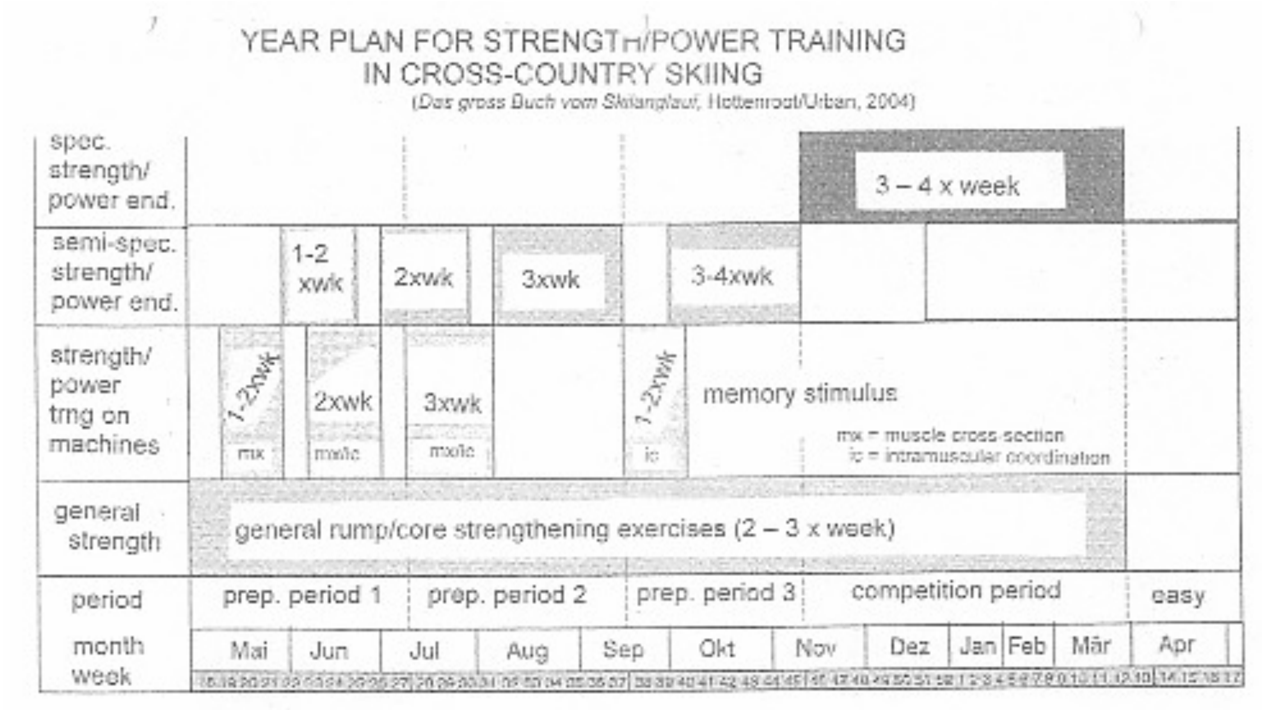
Continuous specific performance training without reduction of loading and resultant insufficient stimulus transformation hinders the condition of supercompensation and thus also highest performance.

The spaces of time necessary for adaptation cannot be shortened! Changes in muscles structure require 4-6 weeks of training. Motor adjustments and their practice are possible in shorter times.

Further Reflections on Speed

The lead categories in training for the development of running performance are speed and duration of loading. From the sports-medical perspective it is to be assumed hypothetically that for a greater movement impulse two physiological phenomena are significant.

First is the larger muscle fiber surface and/or the other an altered nerve command (recruiting) of the oxidating and glycolitic functioning fast-twitch fibers. The movement patters which have become habitual through stereotypical endurance training (directing the slow-twitch fibers) lead in only in a limited way to higher impulse (higher speed). By means of using intensive training methods the activation of the fast-twitch fibers which co-participate in the impulse can be achieved. Because of their physiological characteristics the fast-twitch fibers allow higher contraction speeds and more speed-power development. On the other hand, they are fatigued more quickly than the slow-twitch fibers. By including the fast-twitch fibers in the motor-synchronization program an altered running biomechanics is probably achieved, and hence a greater movement impulse. [cf. Article “Understanding Speed Training.”]



Investigations into the gait (step structure) of triathletes and runners show that in the two sport types there are large differences in producing similar speeds. At the same speed the runner display a more effective gait in comparison to the triathletes. The triathletes have a shorter stride, with higher turnover, and the vertical acceleration is lower. The biological cost for triathletes at the same speed was considerably higher than for runners, they produced more lactate, had a higher heart rate and consumed more oxygen. This example shows that the development of a particular speed can depend on various muscle programs. [cf. Article "The Importance of Running Technique for Skiers"]

The physiological central category in further developing endurance performance seems to be resistance-emphasized)-added specific endurance training in the aerobic metabolism zone (Table 6). This form of training leads through early fatiguing to a sport-specific movement pattern which depends upon recruiting fresh FT and ST motor units. The result of this training demand is the availability of more adapted muscle fibers and a higher resistance to fatigue. The number of recruitable muscle fibers climbs and through their ability to switch over (exchange roles) in case of fatigue the endurance capacity also climbs.

Table 6 Performance Sources in Endurance Training

High total loading of 1000-1500 hrs/yr depending on performance structure and age.
Training quality criterion is sport-specific speed (impulse performance) in the training zones and not training volume.
Loading stimuli must rise in a training year. Besides the necessary adaptations (in "suspension" period) the highest total loading should end about three weeks before peak.

The actual and effective form of raising loading is resistance-enhanced endurance training (aerobic power-endurance development: 3-5 mmol/l for 20-40 min, under 3 mmol/l for over 40-70 min, and 1-2 mmol/l for 70-120min).
Adaptation is assured through regular unloading periods which allow optimal stimulus transformation. Uninterrupted training hinders adaptation and is ineffective; vulnerability to misguided loading and sickness rises.

Repeated training at middle elevations is becoming increasingly necessary to maintain equal chances.

5. Physiological Performance Sources

The structuring of training and performance development in the endurance sports requires in ever increasing measure attention to the insights of national and international training science amd sports-medical physiology. In this endeavor expert knowledge in appropriate form must be regularly brought together. Isolated solutions practice as sports methodology lead in a short time to performance stagnation. If one remains closed to exchanging experience, then chance with be the rule in performance development and preparation. Every advance in endurance performance indicates a new level of sport-specific and individual adaptation in the organism, in accordance with the demands of the performance characteristics. It is always the individual biological tendency which is trained on the basis of advanced empirical knowledge.

Evi Sachenbacher-Stehle May 22, 2006 Training Camp in Crete:

Last week we spent 9 days in Crete, like every year this time....This was no “beach” camp, as some might imagine, but renewed training. Mornings we did between 4 and 6 ½ hours biking in mountainous terrain and afternoons strength training and running.

Jens Filbrich May 28

After a generous regeneration month in April, we began the new training year promptly on May 1. At first we trained in many different ways and in that way called on all the muscle groups. Our companion in that was both muscle cramps and lots of fun. On the schedule were strength work, climbing, in-line skates, cross-country running and every possible sort of sports activity. The bone-rattler was not absent. We spun many kilometers on roads and mountain paths on road and mountain bikes. The high point came between the 20th and 26th with a biking camp in the beautiful Toskana mountains. In 6 stages we covered just short of 700km and climbed almost 12,000 meters [39,000 ft]

Tobias Angerer, September 1, 2006 Goms and Les Diablerets Camp:

We were all 11 days in Switzerland, one week in Goms for roller skiing in the mountains, and then 3 days in Les Diablerets on the glacier for skiing.

The 7 days in Goms were severe enough. Every morning we did a pass....afternoons followed with mostly climbing or running in the surrounding mountains. There is a wide choice of passes in Goms....All are between 13 and 18 kilometers long and ready with more than 1000 meters vertical....The weather this year was better than it was last, and we were able to partly improve our times.

Tobias Angerer Nov. 4 Muonio

Here one can prepare for the season perfectly. A 4km loop on artificial snow in perfect shape and one can ski on natural snow as well. In this camp the volume still remains very high, and many kilometers are skied, in addition to technique and ski testing. Today, for example, I skied a distance from Traunstein to Munich, around 100 kilometers.