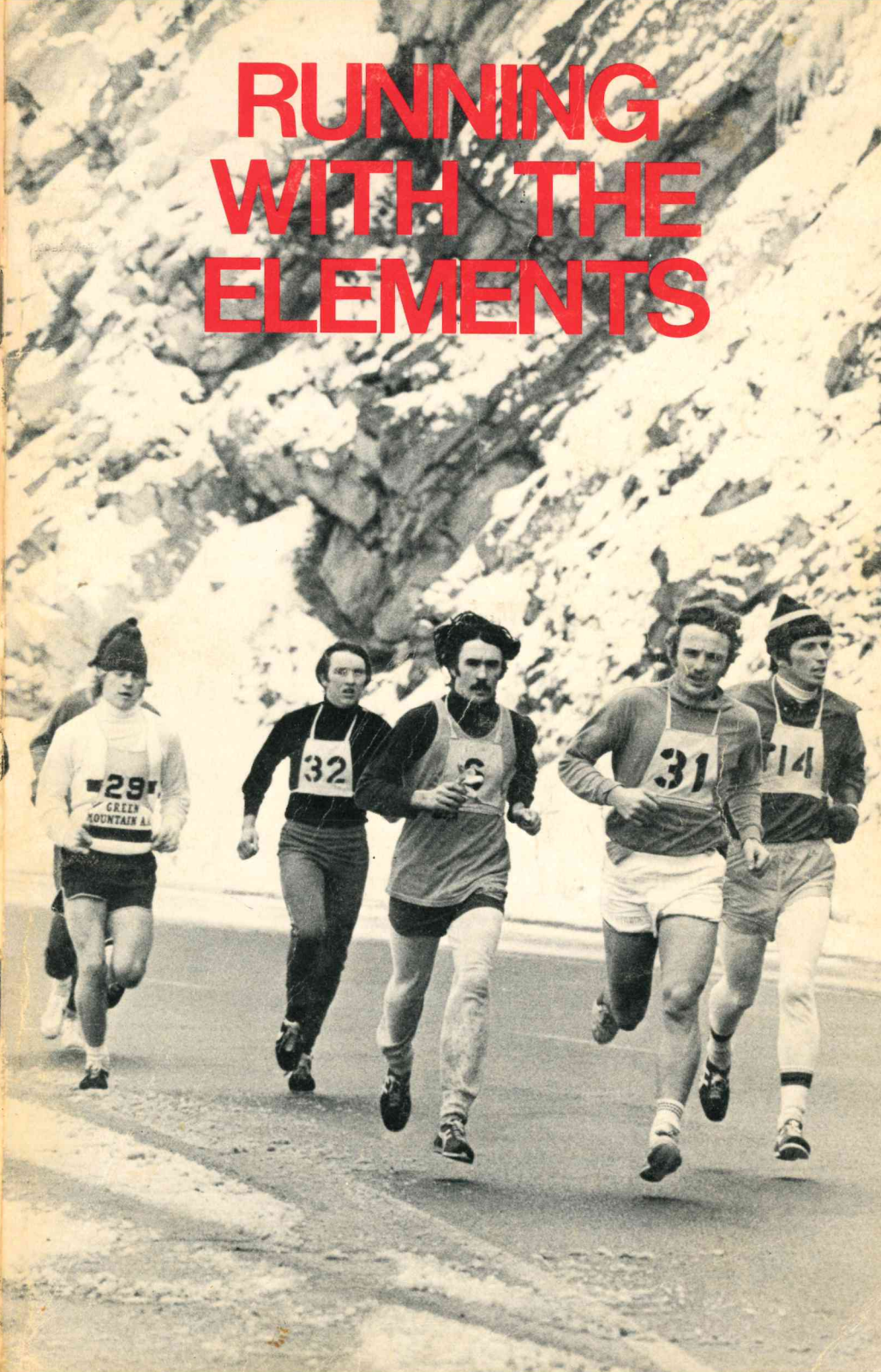
RUNNING WITH THE ELEMENTS



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RUNNING WITH THE ELEMENTS

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CONTENTS

FOREWORD

Is there another animal so intelligent and so arrogant as man? Apparently not, for no other animal has the tools to tamper with his environment, to bend it to his wishes and comforts instead of bending himself as the habitat dictates.

Man has evolved to the point where his buildings and his machines keep him out of day-to-day touch with the elements. Central heating and air conditioning control his temperatures. Insulated walls hold out the storms. Automobiles flatten the hills and shorten the distances. Seldom is his contact with the elements intimate or inescapable.

Unless he runs... If he's the kind of runner who must do it every day, then he knows all about heat and cold, snow and rain, surface and terrain. He fights them and cooperates with them, respects them and fears them, hates them and loves them the way only one who knows them can.

No runner can honestly say he enjoys all the insults and threats nature is capable of hurling at him. But if he wants to keep running, he learns to live with them. He knows the elements aren't going to change for him, so he has to adapt to them as best he can. If he won't bend, he gets hurt.

When runners think of the elements, they think first of heat and cold. Summer and winter temperature extremes are important enough to rate more than one-third of this booklet. But there are other barriers to good running, natural and unnatural.

- **Air and earth**: A few thousand feet climb in elevation takes a runner's breath away. A shift in wind direction turns a fast run into a painful, head-down slog. Hilly runs make more demands than flat ones of the same pace, sloppy surfaces demand more than dry ones.

- **Man-made hazards**: The price of progress and comfort has been dirtying of the air, paving of the earth and crowding into cities and suburbs to support the new style of living. Few runners get to practice in a place where they can smell the clean, feel the soft and listen to the quiet.

- **Man himself**: Man and the pet dogs he keeps are as disheartening to face every day as the worst inanimate insults and threats. The runner feels a little braver for taking on the weather and the distances. His neighbors make him feel cheap with their shouts. Their dogs remind him with their attacks that he's an intruder on their streets.

As we said, there's not a lot a runner can do to change these elements in his environment. There's a great deal he can do, though, to adjust to these facts of life. This booklet is about how to adjust. How to deal with the changing seasons, good days and bad, heat and cold, altitude and air pollution, hills and concrete and cars, dogs and people.

This is a book about the insults and threats in the runner's world, yes. But it's also about the beauty and variety which those who've separated themselves from the natural world don't get to experience. While this is a "Guide to Running Survival" which teaches runners to respect the environmental dangers, it is also a "Guide to Running Appreciation" which points out the satisfaction which comes with accepting the environment on its terms.

Chapter I

LIVING WITH CHANGE

Harry Cordellos (left) is blind. Yet that doesn't keep him from running through the California countryside and enjoying the area's "perpetual springtime." (George Beinhorn)

FOR EVERYTHING, A SEASON

A runner doesn't need a weatherman to know which way the wind blows. He lives with the elements. If he lives anywhere but on the western and southern fringes of the United States, he tastes the extremes of heat and cold as each year flows through its seasonal cycles. And he dreams, on the days when his eyes freeze shut from the cold or he can hear himself sweat in the heat, of moving to a kinder climate–like California's.

Hal Higdon lives in the upper midwest beside Lake Michigan. The northwind of winter rips across the lake and into Michigan City with nothing to slow it. In summer, the big body of water saturates the air with unbearable humidity. But Higdon likes running there.

He writes, "One of the absurdities of life is that many track men, road runners and walkers have moved and are moving to California to further their careers. If pressed, I could probably come up with the names of dozens of young men who have followed Horace Greeley's classic advice to go west. At times, I have been tempted to do the same."

The reasons for moving, says Higdon, seem obvious: "Plentiful competition, many active clubs, year-round outdoor training. Perhaps the last reason has the most appeal. No more slogging through snow drifts. No danger of slipping on ice, or failing even to find a clear running surface at all. No frigid winds. No necessity to pile on double sweat suits, which make running at a seven-minute pace for any length of time a Herculean feat."

Then there are the summer counterparts: Humidity so high that you break a sweat just putting on your shoes. Summer nights that are good for growing corn, but not much else as temperatures don't drop below 80 degrees. Workouts pushed into the pre-dawn and post-sunset hours. Long runs postponed until the next rain arrives. Races that resemble the Bataan Death March.

What runner hasn't envied the ones in California or Oregon on bad days like these? What runner hasn't found reasons to take these days off to dream about better ones? It's normal to do that.

But it's absurd, according to Higdon, to pack up and go to the west coast simply to find perpetual springtime. It's absurd because you may only be trading one set of problems for a new set.

Joe Henderson of *Runner's World* moved from the midwest to California several years ago. When asked what he missed about his old home, if anything, he says, "The change of seasons. The air-conditioned, never-too-cold, never-too-hot climate of California gets boring after awhile. I most miss the winter and summer. Much as I thought I hated them when I lived in Iowa, they helped me appreciate the good days more. When every day is good, you don't have any comparison."

Other runners who've gone west say the same thing. They most miss the elements they were trying to escape–the heat and the cold.

Hal Higdon writes in his chapter on the seasons in *On the Run From Dogs and People,* "There is a certain majesty to the weather in the middle west. Running outdoors as I do, I get to know it. No television weatherman can tell me more than I learn during my daily training runs. I look up, while

running the beach, at puffs of clouds floating over the horizon and know soon it will rain. I touch the northwest wind after it has crossed 60 miles of open lake and understand that winter soon will come."

It's hard seeing any good in the worst of days, but if the runner accepts them and adapts, real benefits can come from them. Two recent record holders in the half-mile and mile have both said so.

New Zealander Peter Snell had to train for both of his Olympics (in which he won three gold medals) in the down-under winter. He said, "I enjoy bad weather because I know that while I'm outside suffering, all of the rivals I'll race next summer are indoors doing nothing."

Jim Ryun once remarked that he didn't envy his competitors in California who ran in shorts in the sunshine while he was trudging along the Kansas backroads in full sweats. He said he felt tougher for having taken on the elements.

Later, after a two year break from competition, Ryun himself moved to Oregon and later to California. When his pre-Olympic training didn't develop the way he'd hoped, Jim returned to Kansas.

The point is that no quirk in the elements is all bad. Temperature extremes, say Snell and Ryun, made them better runners than those who didn't have to endure heat and cold. A cold rain may make a sprinter or hurdler fear for his legs, but it brings delight to the heart of a road racer. Heat, the distance runner's enemy, is the sprinter's friend. Wind slows distance times, but gives sprinters a boost. High altitude works the same way, though distance runners can profit when they come down from long exposures to altitude.

Runners learn to live with what they have. Otherwise, all the good ones would live where they were most comfortable. Most of them would live in California, where year-round climate and opportunity seem best suited to running.

In straight number terms, California does have most of the fastest runners in the country. Of the US leaders (top 50 per event), in 1973, nearly one in four lived there. The next highest states (Texas, Oregon, New York) had about 6% each. But it's also true that California has more people than any other state.

Per capita, California doesn't even come close to leading the nation in output of runners. It ranks only fifth, behind New Mexico, the District of Columbia, Oregon and Arizona. New Mexico is a southern state geographically, yet its elevation gives much of it a harsh climate.

While sprinters and hurdlers are supposed to thrive in hot weather, New Mexico and three other "cold" states—D.C., Delaware and Colorado—all lead California. New Mexico is also the best producer of middle distance talent per capita, and California ranks eighth. Heat and humidity don't bar Hawaii from having the most sub-three-hour marathoners. California is sixth in that event.

This is speculation, but perhaps the climate in California is *too perfect.* Perhaps the day-to-day and seasonal variations in other parts of the country keep runners hungry. Winter and summer extremes keep runners from racing and training too much, which is always a temptation in California where running is never out of season.

A number of authorities have written that a runner can hold peak form

for only a few months. Then he must back off and rebuild. Arthur Lydiard, the successful New Zealand coach, has been quoted in earlier booklets as saying, "You can't race well the year-round because your condition will only take you so far. When you're racing hard, you can't train hard. If you compromise, you can hold your form for three or four months. But (then) you're going to have to go back and start to build up again."

Figures on the world-ranked men and women for one year support Lydiard's contention. Regardless of event, the total length of the top athletes' seasons is 2½-3½ months. The athletes hit their peaks for the year at the end of the second or start of the third month of racing.

SEASONS OF WORLD-RANKED ATHLETES

Event	No. of Races	Best Race	Total Season	Time to Peak
Sprints–Hurdles	6.8	4th	3.3 mo.	1.4 mo.
Middle Distances	5.7	4th	3.4 mo.	2.3 mo.
Long Distances	3.0	2nd	4.0 mo.	2.1 mo.
Averages	**5.2**	**3rd**	**3.6 mo.**	**1.9 mo.**

Based on athletes ranked by Track & Field News (men) and Women's Track & Field World, 1972 and 1973; includes only major outdoor races in their specialty. According to these figures, top-ranked track runners compete 6-8 times in a season, long distance runners and race walkers about three times. The best race is generally the fourth one if they're on the track, the second on the road. At all distances, athletes run their best time at the end of the second or beginning of the third month of the season—and continue racing another month or two beyond their "peak."

Tom Osler, author of *The Conditioning of Distance Runners,* feels that humans have natural cycles built into them which roughly parallel the seasons of the year. He thinks there are two "highs" and two "lows" each year, each lasting about three months. The highs are best for heavy, "peaking" racing, and the lows are a time for recovery and rebuilding training.

If such cycles do exist—and there's no reason to think they don't since all of nature works in cycles—then it's reasonable to assume that a runner shouldn't race seriously for more than three months at a time, and that there should be at least a three-month break between racing seasons.

In winter and summer, when runners in most parts of the country can't go fast even if they want, nature may be trying to tell them something that Californians can't hear so clearly.

PATTERNS OF CLIMATE

BY DR. KENNETH YOUNG

Dr. Kenneth Young, a long distance runner who holds a number of American records, is employed as a meteorologist with the National Center for Atmospheric Research in Boulder, Colo.

The United States is made up of a number of climatic regions and climates vary widely from place to place. For example, the coastal regions of the western US typically have cool, moist weather, characterized by mild, wet winters and dry, cool summers. Inland of the coastal range, winters are colder and summers markedly hotter. This exemplifies the dependence of climate on the proximity of oceans, lakes, etc.—especially when they lie westward of a region. (Chicago, on the southwest end of Lake Michigan, experiences colder winters and less snow than do regions on the east and southeast of the lake.) Thus, if the city or town of interest to you is not listed here, choose a city listed which is not only close geographically but may be expected to have a similar climatic regime, considering factors such as nearby oceans and lakes, altitude and location in valleys (valleys collect cold air in winter and at night).

The figures presented reflect long-term averages for the most part. As everyone knows (at least in the northern half of the country), the day-to-day weather exhibits marked changes. These changes are greatest in the winter and smallest in the summer. The daily consistency of temperature can be estimated by comparing mean temperatures with corresponding extremes. For example, Honolulu shows little day-to-day change, whereas Denver shows large changes. Hence, one can expect the averages to reflect reasonably well the weather expected in Honolulu while in Denver during the winter one had best be prepared for anything.

The conditions which basically determine wintertime running speed and comfort are related to snow and, to a lesser extent, temperature and wind. The runner is interested not only in how much snow falls and how frequently, but how long it remains on the ground. Thus one needs to consider (1) the total snowfall, (2) the number of snow days and (3) the mean maximum temperature for January. For example, Denver receives 65% more snow than Chicago, but the percentage of time roads and sidewalks are snow/ice-covered is probably less since the daytime temperatures in the winter are higher in Denver.

Running in cold weather is aggravated by winds and partially alleviated by sunshine. Thus, factors such as percentage of sunshine and wind velocities are important variables in determining comfort. It should be noted that high winds in the lee of the Rockies are frequently Chinooks (i.e., warm, dry winds), whereas high winds in the Great Plains and eastward to New England are frequently associated with storms bringing snow and cold air.

Running comfort in the summer is determined by temperature and humidity. Since the lowest temperatures generally occur near dawn, one can avoid daytime heat by running at sunrise. A rough rule of thumb is that summer training may be curtailed by the weather where the average July minimum is 68 degrees of higher *and* the average July humidity is greater than 50%. For example, in Phoenix, one can run fairly high mileage provided you run early

in the morning, despite afternoon temperatures well over 100 degrees. In Miami, the combination of high temperatures and humidity make running at any time of the day highly unpleasant.

Tables give the following data:

- **Temperatures**: Mean daily maximum/minimum temperatures for July and January. All-time maximum/minimum temperatures.
- **Relative humidity**: Average humidity for July (averaged over all hours of the day).
- **Precipitation**: Average annual precipitation (rain plus melted snow). Season of heaviest precipitation given when significant seasonal variations occur. Average annual snowfall (T indicates "trace," or less than one-half inch). Rain days gives number of days with precipitation (above 0.01 inch). Snow Days gives number of days with snowfall (above 1.0 inch).
- **Sky Cover**: Number of days classified as clear, partly cloudy and cloudy. Number of days with fog. Percentage of possible sunshine.
- **Winds**: Average wind velocity (mph) and prevailing direction (direction refers to the direction wind comes from).

CANADA AND MEXICO

City	Jan. Mx./Mn.	July Mx./Mn.	Record Mx./Mn.	July R.H.	Ann. Ppt.
Calgary	24/2	76/47	97/-49	50%	17"
Montreal	21/6	78/61	97/-29	52%	41"
Vancouver	41/32	74/54	92/2	62%	57"
Toronto	30/16	79/59	105/-26	56%	32"
Winnipeg	7/-13	79/55	108/-54	53%	21"
Mexico City	66/42	73/53	90/27	50%	29"

WESTERN UNITED STATES

Cities	Jan. Max/Mn	Jul. Mx/Mn	Jul. RH	Record Mx.	Record Mn.	Ann. Ppt.	Season	Ann. Snow	Rain Days	Snow Days	Fog Days	Sun	Clear Days	PCld. Days	Cld. Days	Wind
Albuquerque	46/22	92/66	33%	104	-5	9"	Sumr.	11"	58	4	5	76%	173	114	78	9 SE
Anchorage	20/6	65/49	62	86	-38	14	Smr-Fll.	61	104	21	26	45	71	85	209	6 N
Bakersfield	57/37	101/67	19	115	21	6	Smr.	T	38	0	20	80	202	81	82	9 SE
Boise	35/20	91/59	34	111	-17	12	W-Spr.	21	90	8	19	66	125	94	146	9 SE
Los Angeles	65/45	83/62	53	110	28	15	Wntr.	T	37	0	17	74	185	106	74	6 W
Phoenix	65/35	105/75	31	118	17	7	W-Smr.	T	34	0	2	86	209	84	72	5 E
Reno	46/17	92/47	19	104	-16	7	Wntr.	24	47	8	9	78	171	91	103	7 WNW
Salt Lake City	36/17	92/61	27	107	-30	15	Sprg.	52	86	17	10	69	91	106	123	9 SSE
San Francisco	55/45	64/53	75	106	30	21	Wntr.	T	67	0	30	66	146	123	96	9 W
Seattle	43/31	75/53	48	100	0	34	Wntr.	16	163	5	53	45	54	82	229	11 SW
Honolulu	77/67	82/74	56	88	57	24	Wntr.	0	148	0	0	70	101	169	95	12 ENE

CENTRAL UNITED STATES

Billings	32/13	88/59	40%	106	-38	13"	Sprg.	54"	92	19	18	62%	92	121	152	11 SW
Chicago	33/17	85/64	51	104	-15	33	Spr-Sm.	36	120	10	17	58	96	102	167	10 SSW
Denver	42/16	87/58	32	105	-30	14	Sprg.	59	86	18	10	69	113	137	115	10 S
Duluth	17/-1	77/56	61	97	-35	30	Sumr.	76	132	22	52	56	80	103	182	13 NW
Louisville	44/26	89/67	54	105	-19	42	Sprg.	15	123	5	10	57	102	101	162	9 S
Minneapolis	23/6	85/63	54	104	-31	25	Sumr.	40	112	12	12	58	105	100	160	11 NW
Omaha	32/14	89/68	52	114	-22	26	Sumr.	32	95	9	15	62	116	108	141	11 SSE
Rapid City	33/9	86/59	41	109	-27	17	Sp-Sm.	37	94	11	14	62	108	116	141	11 NNW
St. Louis	41/26	90/72	50	115	-12	38		15	110	6	8	60	128	106	131	12 S

SOUTHERN UNITED STATES

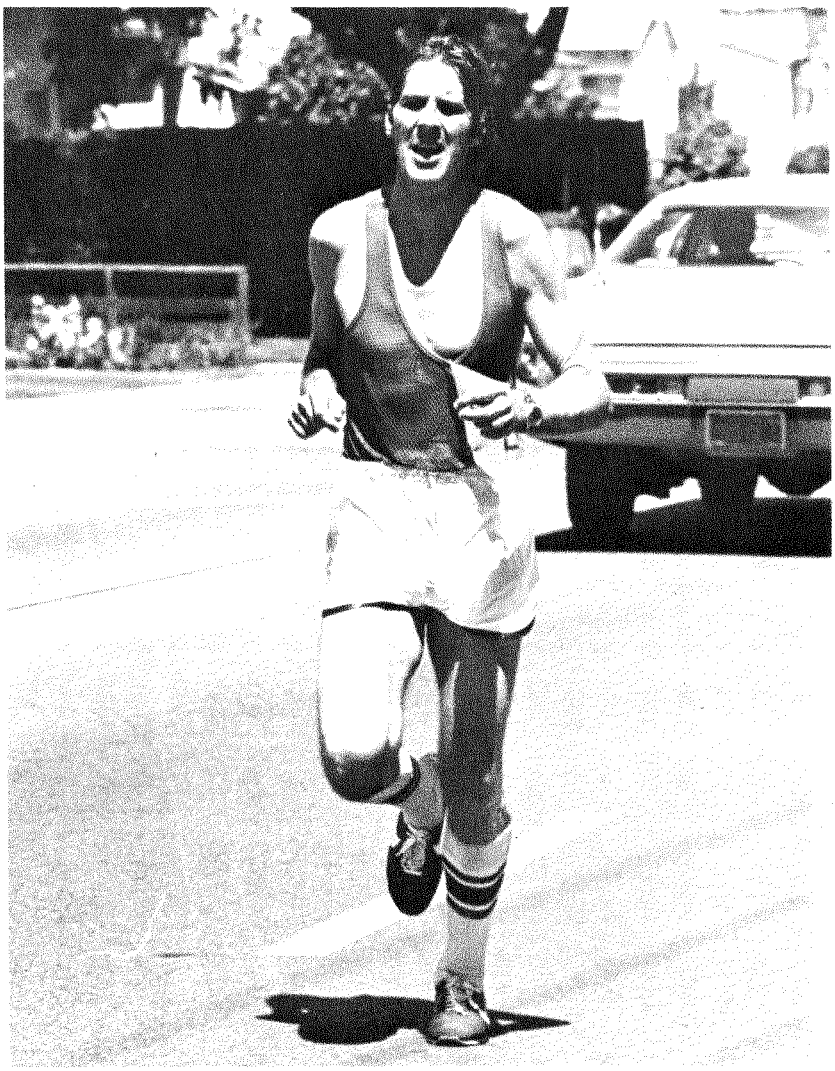
Atlanta	53/36	89/70	58%	103	3	49"		2"	117	½	26	60%	110	110	145	10 N
Brownsville	70/51	93/75	55	104	22	28	Fall	T	73	0	24	61	97	138	130	12 SE
El Paso	56/31	94/69	36	109	-6	8	Sumr	4	44	1	1	82	194	99	72	11 N
Houston	62/46	92/75	58	105	10	45		T	106	½	16	59	95	123	147	10 SE
Jacksonville	66/45	91/73	57	105	17	52	Smr.	T	117	½	35	59	100	127	138	9 NW
Memphis	50/33	91/71	56	106	-11	50		5	102	2	11	63	119	101	145	10 S
Miami	78/59	91/74	64	98	32	56	Smr-Fll.	0	128	0	6	67	87	174	100	9 SE
Montgomery	60/39	91/71	57	105	8	54		T	111	½	21	63	107	108	150	7 S
New Orleans	64/48	90/76	63	102	17	64		T	119	½	15	61	119	101	145	7 S
Okla. City	47/27	93/71	53	107	-4	30	Spg-Smr.	10	82	3	17	68	151	95	119	14 SSE
Raleigh	51/32	89/68	56	105	0	45		7	118	1	33	61	118	107	140	8 SW

EASTERN UNITED STATES

Boston	37/22	80/64	54%	100	-12	39"	40"	133	10	23	58%	98	107	160	13 SW
Burlington	28/8	82/58	54	101	-30	32	69	151	19	23	48	61	106	198	9 S
Columbus	38/22	86/63	52	104	-15	38	29	135	8	20	55	78	106	181	8 SSW
Detroit	33/19	84/63	51	105	-16	31	32	133	11	11	54	81	106	178	10 N
New York	40/26	82/67	58	102	-14	42	30	124	8	20	60	104	131	130	15 NW
Philadelphia	41/25	87/66	52	102	1	41	18	120	5	30	57	88	117	160	10 SW
Washington	44/29	86/68	53	103	1	41	15	115	5	13	56	101	106	158	10 S

Chapter II

WHEN IT'S HOT



A runner on the roads can generate body heat well above 100 degrees—even on cool days—and must dress for his own temperature as well as the day's. (George Beinhorn photo)

HOW HOT IS "TOO HOT"?

BY DR. GEORGE SHEEHAN

Dr. Sheehan is medical editor of Runner's World and author of the Encyclopedia of Athletic Medicine.

"Violent chills, spinning head, black spots before the eyes just past the 16-mile mark. Had only one small gulp of Gatorade, no water and lost 12 pounds." So wrote a veteran runner who had wisely dropped out of the 1973 Boston marathon. A dozen less fortunate entrants ended up in the hospital, one eventually died, and almost 400 others used public transportation to reach the finish line. Seventy-nine-degree heat—unexpected, inadequately prepared for and incompetently handled—had done them in.

How hot is hot? When does heat become a threat to the athlete? British Olympic physician Adolphe Abrahams wrote in 1950, "In a healthy subject, the only potential risk to life is heat stroke." In the ensuing 24 years, the medical profession has been trying to give guidelines to coaches, physical education instructors, trainers and athletes on ways to estimate heat stress and how to handle it.

There is now general agreement about what to do: fluids, fluids and more fluids. This is the first priority. Loss of more than 3% of body weight can cause a rise in rectal temperature to 106 degrees and put the athlete in danger of heat exhaustion or even heat stroke. (My 150-pound friend had survived a loss of 12 pounds or 8% of his weight.) The amounts of fluid lost and therefore needing to be replaced can be astounding. (The 16-mile dropout had sweated almost six quarts.)

The second priority is sodium chloride (salt), then potassium. These electrolytes, as they are called, are found in the commercial "Ade" drinks, though sometimes in insufficient quantity.

And most of the physiologists agree that the current international rule that no water or fluids be given out before the seven-mile mark is criminal. It represents a philosophy that is in the same category as the coaches who still advise their athletes not to take any water, "Just rinse out your mouth."

"Marathon runners appear to be unaware of the dangers of dehydration," writes Cyril Wyndham, a South African physiologist, "and most of them refrain from any but small amounts of water during the run." Even in Dr. Kenneth Cooper's *New Aerobics*, the athlete is advised to replace fluid losses *after* the activity.

The "no-water" myth has a counterpart in the "high-salt" myth. If a little salt is good, then a lot will be better. Actually, salt replacement should parallel fluid replacement or the athlete will be in even more trouble.

Some of these misconceptions are caused by the jargon in which Ph.D.'s wrap their information. Coaches and runners have gotten the impression that temperature alone is not the problem. This is true. Heat stress is a complicated equation that includes humidity, solar radiation and other factors like convection and conduction. All these plus the Wet Bulb Globe Temperature index are enough to tax a physics major. The WBGT, for instance, is derived from 0.7 times the wet-bulb temperature plus 0.2 times the black-globe temperature

plus 0.1 times the standard shade temperature. Now you know no one is going through all those calculations, much less get the equipment to do them.

How hot is hot? We'll never know if we depend on figuring out the WBGT. In its place, I suggest we use the Temperature-Humidity Index, which is readily available from the weather bureau. When the THI is 75, you go on alert. When it is 79, you are in danger. And when the THI is 83, you have an emergency situation. At that level, all competitive activity should be cancelled.

The best thing to do, then, is to ignore the undying myths, the obfuscating jargon of the professionals, the reliance on over-instrumentation. Regard heat with the respect it deserves. Get to know how your body reacts to changes in your environment. The guidelines I suggest are simple:

- Take an hour a day of increasing activity for two weeks to acclimatize to heat.
- Take fluid early and often, a minimum of 10 ounces every 20 minutes.
- Take fluids with adequate electrolytes—Gatorade, Sportade, ERG, orange juice half and half with a weak salt solution, or tomato juice with equal amounts of water.
- Use the THI as your guide to increasing fluids and decreasing activity. Observe the alert, danger and emergency levels, and cancel practice or competition if necessary.

How hot is hot? It could be a warm and humid and tragic Patriots' Day in April if you aren't aware.

STAY ALIVE ABOVE 75

The 1973 Boston marathon was a killer. For the first time in the long history of the race, a runner died from it. Harold Gale, a 44-year-old from Connecticut, collapsed during the race. He died several weeks later. First word was that he had suffered a heart attack (Gale had a history of heart disease). The final verdict, however, was that heat had killed him.

The temperature at Boston had been an unseasonal 79 degrees, highest on record for an April 16. Few runners had prepared for that kind of heat. Dr. George Sheehan, one of the runners, reported, "Only 600 of the 1400 starters certified as being capable of running a marathon in 3½ hours actually did so. Almost a dozen ended up in hospitals with exhaustion, and hundreds of others walked in long after officials had departed."

"Again," Sheehan added, "it was a case of inadequate human knowledge replacing the fundamental intuitions of the body—man-made goals and predetermined pace taking precedence over the subconscious perceptions the runner gets from his body."

The obvious message the body is giving on a hot day is "Slow down!" But when good sense gets tangled up with ambition and the excitement of the run, body-wisdom seldom prevails. The result is mainly a concern of distance runners—the longer the race, the more concern. In fact, heat is something of a friend to sprinters because it warms up their muscles quickly and thoroughly, and they aren't active long enough to overheat.

As distances grow, though, heat is an increasing problem. Without trying to step too far into the physiological territory reserved for specialist David Kaufmann (see article that follows), this is what happens:

According to Dr. Richard Westerman, medical consultant to *The Trainer* magazine, "A simple stroll doubles the body's heat production, playing football increases it approximately 20-fold, and a sprinter can briefly increase heat production a hundred-fold. The proportionate amount of this heat which is lost depends on ambient (surrounding) environmental conditions. It should be obvious that on a hot day there will be a reduced capacity for air to take up this heat as its temperature approaches that of the skin."

In other words, the heat produced inside the body must have an escape. If none is available, internal heat climbs. On hot days, says Dr. George Yamamoto, a physiologist at George Washington University, "You are literally in a state of exercise while standing still. Your body is working a lot harder to stay cool."

Sprints, as mentioned, don't normally last long enough for heat stress to cause trouble. But trouble can and does occur in distance racing and training. At the extreme, hot weather can produce heat exhaustion, which is most unpleasant, or heat stroke, which is often fatal.

Heat, particularly when combined with high humidity (which further reduces the body's ability to throw off heat through evaporating sweat), can kill. It happens, and everyone who runs should be aware of the danger, though fortunately the incidence of fatal heart attacks is small.

Heat, however, kills in subtle ways as well—even when it doesn't cause

death or permanent injury. Everyone who runs distances has experienced its killing effect on pace and race plans, and on the spirit. The idea here, as it was in a 1971 *Runner's World* article, is "to show why this happens, to assure you the slowdown is beyond the control of your will-power, to give a healthy respect for the devastating effects of hot weather and to suggest ways to avoid these demoralizing 'death marches.' "

The best US marathon race year after year is Boston. As the field grows, and standards go higher, the running there gets better each time. But runners never are beyond the power of the thermometer. It sets the pace of the race. Look at the quality of the Boston race over the past several years and see how closely temperature controls it (listed are the percentages of the field breaking three hours):

Year	Conditions	% Below 3:00
1967	low 40s, rain	24%
1968	mid 70s, sunny	7%
1969	mid 60s, sunny	13%
1970	low 40s, rain	27%
1971	mid 60s, sunny	26%
1972	high 60s, sunny	25%
1973	high 70s, sunny	17%

Regardless of the steady improvement in the class of runners at Boston, 70-degree days still take a great toll. Notice what happened in 1968 and 1973. Notice too, that the best Boston year, 1970, was one of the coldest and wettest.

What is the ideal temperature for running and racing? The *RW* article "Coping with Heated Battles" suggested, "The widely-voiced theory is that the 40-60-degree range is best. We can go a bit lower on the cold side, but not much higher in warmth without suffering."

As evidence, the article presented figures from one year's marathons. Well over half the runners had their best times that year on days in the 40s and 50s—this despite the fact that fewer than one-sixth of the races were run under those temperatures.

We aren't worried here about fast times, though. We're concerned with protection from the heat, and the level at which it becomes, first, uncomfortable and then dangerous. It isn't possible to list precise figures because there are complications—the most important being humidity. A wet 70-degree day can be as unbearable as a dry one in the 90s.

Other complications are wind, which can speed the evaporation of sweat and make the day seem cooler; cloud cover, darkness and shade which screen or eliminate the sun's direct rays; surface (there is less reflected heat from grass than from asphalt or concrete); time of year (a runner is naturally more adapted to heat in mid-summer than during a sudden early-spring hot spell; length and intensity of activity; and of course individual differences in heat tolerance.

But in general there are certain upper limits to heat tolerance during running. The best available guide to these limits is a reading which combines heat and humidity. One such scale, the Wet Bulb Globe Temperature (WBGT)

is described by Dr. Kenneth Cooper in his book *New Aerobics.* Cooper recommends the following WBGT standards:

- **below 80 degrees**—"vigorous activity is relatively safe."
- **85 degrees**—"only those people who have been exercising in the heat for at least *10* days can continue their workouts."
- **88 degrees**—"only those people who have been exercising in the heat for at least *30* days can continue vigorous outdoor workouts."
- **90 degrees**—"it is best for all individuals to stop vigorous outdoor exercise regardless of the state of conditioning or heat acclimatization."

Dr. Richard Westerman, writing in *The Trainer,* is more cautious than Cooper. Westerman says, "From a practical point of view, there is only one figure which really must be remembered—75 degrees. Wet-bulb readings above 75 degrees will always be associated with either an oppressive mugginess or conditions highly conducive to heat stress."

Westerman bases his recommendations on the Temperature-Humidity Index for livestock safety—"that's right, livestock, not humans. Originally, these indexes were developed for human guidance, but no one was sure of the critical levels. Later observations showed that there was an excellent correlation for certain values and livestock deaths." Later still, it was seen that athletes suffered heat stress symptoms at similar levels.

Westerman writes, "A THI below 75 is considered *safe.* An index between 75 and 78 is called the *alert* state. This does not mean there is any cause for alarm or that there is a need to take special precautions. However, if conditions are found to be at the alert level early in the day, they may progressively worsen to the point where the *danger* state would ensue.

"When danger (above 78 degrees) levels occur...I interpret this to mean remove excess clothing, assure good ventilation of the skin, take frequent work breaks and consider reducing the intensity of work if the temperature rises.

"*Emergency* conditions are defined as occurring whenever the THI is over 83. For man, I translate this to mean, 'Forget it. It's just too damn hot!' "

Okay, so how do you know what the WBGT or THI reading is? If you want to go to the trouble, you can buy or make your own apparatus for checking WBGT:

- A standard thermometer shaded from the sun.
- A black-globe thermometer exposed to the sun and prevailing wind.
- A stationary wet-bulb thermometer similarly exposed.

The reading is determined by adding seven-tenths of the wet-bulb temperature, two-tenths of the black-glob temperature and one-tenth of the standard thermometer temperature.

But there's a much easier method, says Dr. Westerman: "When you don't have the equipment to make your own wet-bulb readings, a phone call to the nearest weather bureau station will provide reliable information—even when the station is some distance away.

"The problem with calling the weather bureau is that not all stations routinely record the wet-bulb temperatures, but instead record the *dew-point.* and calculate relative humidity from this... At high relative humidities, the

dew-point and wet-bulb temperatures are approximately identical, but at low humidities the dew-point is always several degrees lower. Again, for practical purposes we need to remember only one figure—75 degrees." (The three accompanying charts illustrate wet-bulb, dew-point and combined readings.)

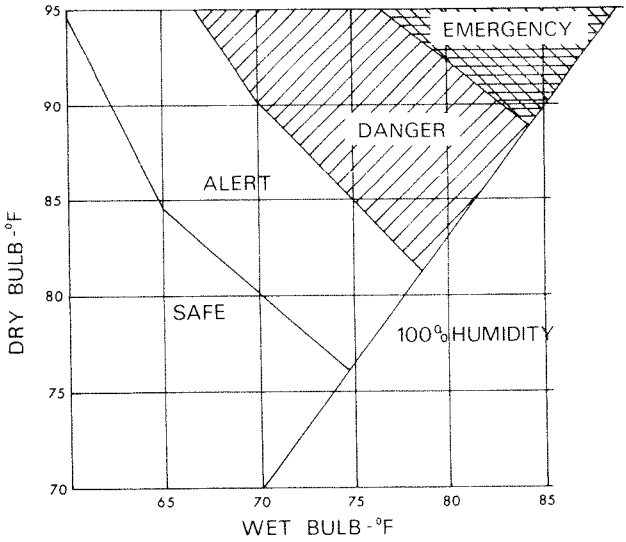
Fortunately, runners can adapt to some extent to heat through the phenomenon of acclimatization, and can tolerate it if they realize Dr. David Costill's maxim that they "will never produce as fine a performance as might be expected on a cool, cloudy day."

Adjusting to heat demands attention to Dr. George Sheehan's "three P's: preparation, pace and perspiration." Realizing why heat will always slow you down, or worse, demands knowledge of the fourth P: physiology and its limits.

INITIAL CONDITIONS FOR SAFETY INDEX

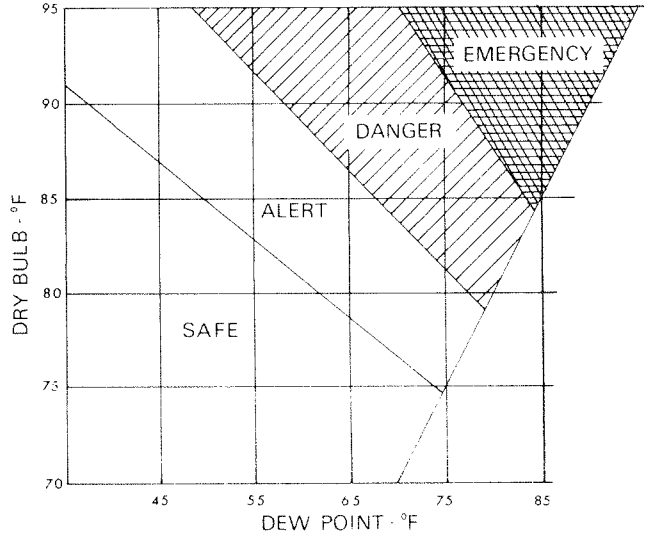
	ALERT			DANGER			EMERGENCY		
	THI=75			THI=79			THI=84		
DB	WB	DP	RH	WB	DP	RH	WB	DP	RH
75	74	73	95						
76	74	73	90						
77	72	70	80						
78	71	68	70						
79	70	66	65	79	79	100			
80	70	65	60	78	77	90			
81	68	61	50	77	76	85			
82	67	59	45	76	73	75			
83	66	56	40	75	72	70			
84	65	54	35	75	71	65	84	84	100
85	64	50	30	74	70	60	83	82	90
86	65	51	30	73	68	55	82	81	85
87	63	47	25	73	66	50	82	80	80
88	62	42	20	72	64	45	81	79	75
89	63	43	20	71	62	40	81	78	70
90			15	70	59	35	80	77	65
91				70	59	35	79	75	60
92				69	56	30	79	74	55
93				67	52	25	79	74	55
94				68	53	25	78	72	50
95				67	48	20	77	70	45

LIVESTOCK SAFETY INDEX
TEMPERATURE – HUMIDITY INDEX



+National Weather Service Operations Manual.

LIVESTOCK SAFETY INDEX
TEMPERATURE – HUMIDITY INDEX



+ Adapted from Weather Service Operation Manual.

HEAT QUESTIONS, ANSWERS

BY DR. DAVID KAUFMANN

Dr. Kaufmann, an exercise physiologist at the University of Florida, subtitles his article "Everything you wanted to know about running in hot, humid weather and were afraid to ask." He says, "The difference between successful and unsuccessful performance in running is often the simple result of maintaining a balance between heat gain and heat loss in the body." Here, he answers often-asked questions related to heat.

- **How can heat of the body be increased during a run?**

The heat of the exercising body can be increased in one of four ways:

1. Its own metabolism—the energy processes due to molecular activity create heat in the form of kinetic energy.

2. Conduction—the transfer of heat between two objects of dissimilar temperatures and which are in direct contact to each other. In running, heat can be transferred by conduction within the body between adjacent tissues of different temperatures.

3. Convection—the transfer of heat by movement of a fluid (or gas) over a surface of a different temperature. In running, a warm rain or the hot exhaust emission from an auto may increase the heat level of the athlete by convection.

4. Radiation—the transfer of heat via electromagnetic waves between two objects of dissimilar temperatures. In running, heat of the body can be increased by the transmission of thermal energy from the sun.

- **In which direction does heat flow?**

Heat always travels from hot to cold. If the temperature of the object is above that of the surroundings, heat flows away from the object. If the temperature of the object is lower than the environment, heat flows to the object.

- **How can the heat of the body be reduced during a run?**

The heat of an exercising body can be reduced by:

1. Conduction—While running, one could place an ice pack on the head, and the heat from the head transfers to the ice pack.

2. Convection—While running, a cool breeze or a spray of cold water transfers body heat to the breeze or water.

3. Radiation—While running, the body gets hot and the loss of heat via radiation is small and insignificant. However, dark, rough surfaces reflect little or none of the energy which strikes them; light, shiny surfaces reflect some of the radiation from the sun. Hence, heat gain from the sun may be diminished by wearing loose-fitting, light-colored clothes.

4. Evaporation—This is the process of changing a liquid to a vapor whereby heat is absorbed from the surface via kinetic energy. While running, the sweat glands are the only bodily mechanism available for reduction of the body temperature when the environmental temperature is higher than the body's.

• **Can these physiological concepts be presented by some simple formula?**

Quantitatively, the relationship of heat gain and heat loss can be expressed by the following formula:

$H = +M \pm C_d \pm C_v \pm R - E$

H = change in body heat storage; M = heat gain due to basal metabolism plus exercise metabolism; C_d = heat gain or loss via conduction; C_v = heat gain or loss via convection; R = heat gain or loss via radiation; E = heat loss via evaporation.

• **Which one of the above physiologic concepts is the most important during running?**

In an environment in which external temperature is above skin temperature and during exercise when metabolic heat production is greatly accelerated, the primary means of body heat loss is via evaporation. It is therefore important for the runner to promote evaporation in every way possible.

• **What can a runner do to promote heat loss?**

Heat loss can be promoted by:

1. Adequate water replacement to provide for the liquid building blocks of sweat.
2. Adequate salt replacement to provide for the necessary mineral content of sweat.
3. Proper acclimatization of the body to the environmental conditions of the run, because acclimatized individuals have demonstrated sweat rates 20% to 30% higher than non-acclimatized individuals.
4. Make as much of the skin surface as possible exposed to the circulating air in order to facilitate evaporation of sweat.

• **Should the runner wear a shirt?**

If there is little or no sun, not wearing a shirt would expose more of the skin's surface area for evaporative function. However, if the sun is shining with great magnitude and is bombarding the runner with direct rays, a white, loose-fitting, nylon mesh shirt would offer some protection from gaining heat via radiation while still allowing for some ventilation that would remove the blanket of sweat-saturated air from the skin surface that is necessary to facilitate evaporation.

• **Should the runner wear a hat?**

Under the same conditions, the same principles for wearing a shirt apply here. The hat should be colored white, of lightweight nylon material and be of a ventilated design. However, if the sun is not a heat gaining factor, it is better to expose the body surface of the head to the circulating air.

• **Should the runner wear a sweat band around his forehead?**

As far as can be determined, the reason for wearing a sweat band is to keep the sweat or hair out of the eyes. This is more of a convenience than an advantage, for the sweat band does not promote evaporation of sweat. In fact, it covers up a skin surface area densely populated by sweat glands and ducts, which inhibits the secretion of sweat. It also prevents circulating air to come in contact with the covered skin surface. The runner has to decide whether the convenience is worth the loss of evaporative skin surface needed to cool the body.

• **Does the skin act as a reflector (white body reflector) or a non-reflector (black body radiator) of the sun's heat rays?**

The human skin is a black body radiator irrespective of the actual skin color. White skin reflects about 30-40% of the sun's total radiation spectrum, while black skin tends to reflect less than 18% of these rays.

• **If the air temperature is above the body temperature, can the runner still lose heat via evaporation?**

Air temperature may be above body temperature. But as long as the air is not fully saturated with water vapor, sweat can evaporate from the skin surface and the body will be cooled. Increased humidity imposes a heat loss barrier to the evaporative mechanism.

• **Is it possible to lose fluids without sweating?**

Yes. Water can leave the body in the absence of active sweating by diffusion of water through the lung in the form of an expired gas. This is called insensible perspiration, and it is estimated that approximately 25% of the total metabolic heat is carried away by this method.

• **What role do the heart and blood play in sweating?**

At the start of exercise the demand for blood to the working muscles is predominant and blood flow to the skin is reduced, resulting in a fall of skin temperature. As the runner continues to exercise, sweating begins and increased evaporation produces a further cooling of the skin. The reduced skin flow, combined with increased metabolic heat from the work, results in a rapid rise of internal body temperature. After a while, the demand for heat dissipation predominates and skin blood flow increases. This shift in skin flow now puts a demand on the heart which still must continue to supply blood to the working muscles. In other words, the heart is trying to serve two masters: the working muscles and the sweat glands. When the heart cannot supply both adequately, a heat disorder results and the work output drops abruptly.

• **What are some of the common heat disorders that could occur?**

The most common heat disorders are:

1. *Heat cramps*—painful, sudden, involuntary contractions of specific muscles or muscle groups.

2. *Heat exhaustion*—a complete failure of the cardiovascular system due to vasomotor collapse which causes an increase in heart rate, palpitations, nausea, vomiting and finally fainting. The skin remains moist since the runner continues to sweat.

3. *Heat stroke*—a complete failure of the thermoregulatory system which suppresses sweating. The runner's skin will be hot and dry. Since the runner may develop convulsions or go into a coma or even collapse, this condition constitutes a true medical emergency.

Keep cool! That's the first law of long distance racing. Keep cool on the outside with minimal clothing and douses with water, and on the inside with cold drinks. This German runner is well taken care of in all categories. (Rhein-Ruhr photo)


282

• **Are there any basic causes of these three heat disorders?**

The common denominators of all three of these heat disorders are:

1. Heat exposure to the body.
2. Loss of body water.
3. Loss of body salt.
4. Heat storage inside the body.

• **Which one of these is the most important factor for the exercising runner?**

The loss of body water is the most important factor in easing heat disorders.

• **Does this mean that a runner should drink plenty of fluid before, during and after a run in hot, humid weather?**

If the runner will be running for more than 30 minutes, he should definitely replenish his system with liquids. For a marathon, the runner should drink moderate amounts of water (approximately one pint) about 10 minutes before the run starts and drink some liquid at least every 20 minutes during the run to be on the safe side.

• **What liquids should a runner drink during a run?**

The runner should drink primarily water. Each runner should also experiment with other liquids to see what his digestive system can tolerate and intersperse some nutritional drinks with water during the run. Suggested nutritional liquids are: Gatorade, Electrolyte Replacement with Glucose (ERG), Hawaiian Punch, Hi-C Fruit Drinks, Kool-Aid and Seven-Up. It should be emphasize that carbohydrate supplementation during a run is of secondary importance to ingesting the necessary water that is needed to minimize dehydration.

• **Should a runner stuff himself with salt or salt tablets before a long run in the hot, humid weather?**

No! Too much salt would interfere with the sweat rate by causing water from the plasma to converge to the gastrointestinal tract. This would increase the probability of gastrointestinal pain, nausea and vomiting. A runner must replace salt only in the proper proportion to that which is lost via sweating so that the correct salt balance is maintained in the body.

• **How hot can a runner get during a run?**

Studies have reported rectal temperatures in excess of 105^{o} after races of six to 26.2 miles.

• **How much sweat can a runner lose during a run?**

Sweat losses during distance races in hot, humid weather may total 6% to 10% of the runner's weight.

• **What suggestions would you make to the managers of distance races in order to protect the health of the runners during hot, humid weather?**

The following suggestions are made:

1. Sponsors of distance races should try not to schedule long races during the hot summer months. If they are held during hot or humid weather, all distance races should be conducted during the coolest part of the day.
2. Rules that prohibit the taking of fluids during the first 11,000 me-

ters (about seven miles) of a race must be changed to permit fluid ingestion early and at frequent intervals. Because of high sweating rates and body temperatures during distance running in the heat, fluid stations should be provided at least every three miles for all races of 10 miles or more.

3. Since thirst can be an inaccurate estimate of body water needs, runners must learn to consume fluids (four ounces or more) at regular intervals (every three miles). In order to prevent gastric filling and to promote maximum absorption, the fluids ingested should contain minimum amounts of glucose (less than 2.5 grams per 100 milliliters).

4. A shaded, recovery area should be set up near the finish of the race. This area should be staffed by a physician, preferably one experienced in sports medicine, and some first aid attendants. It should have room for the runners to lie down, and it should be equipped with ice packs, cold water, and assorted drinks. An emergency vehicle should be present to transport any serious cases to a hospital emergency room. The race should also be patrolled by an emergency medical vehicle.

PROTECTING THE RUNNERS

How fast a runner goes is his own business. Others can give good advice or opportunities which provide a setting for successful running, but the choice to use the advice and opportunity is the runner's own to make. The responsibility for bringing out the best in himself is his own. No one can do it for him.

When we talk about safety, however, the responsibility for protecting a runner form the worst that can happen to him is a shared one. And when we talk of running long distances in the heat, the responsibility can be a life-or-death one. Coaches, event organizers, fellow runners, even spectators share the obligation of keeping heat from killing—simply because an eager runner faced with the choice of running and not running will almost always choose to run, whatever the conditions. It's a failing we runners have, this not knowing when to stop.

Coaches should be prepared if necessary to grab their runners by the T-shirts and physically hold them back on hot days. Fellow runners should be ready to pull their friends off the course for their own good if they see them in heat trouble. Onlookers should be in a position to give immediate first aid to anyone who collapses in a run or race. It may save a life.

But race organizers bear the heaviest responsibility for the health of runners. These officials put runners in situations where they're most susceptible to heat stress. If long races on the hottest days of summer are available, people will fill them at great risk.

Yet whether because the organizers don't know the risks or don't care, they persist in scheduling long races in July, starting at mid-day and not having enough of the right kinds of drinks on the course. Not many races are guilty of this, but one is too many. The risks of running in extreme heat are so great that any official who doesn't do everything possible to protect runners is grossly, almost criminally, negligent.

This is what can happen, says Dr. George Sheehan: "The unconditioned athlete is usually the victim—unconditioned and unacclimatized to heat. If he loses 3% of his body weight, he is at hazard. Double that and he may not get another warning. Symptoms are gradual and subtle. Before the athlete is aware of what is going on, he is no longer in control of his fate."

This is when he becomes the responsibility of others. Internal temperature has climbed to dangerous levels, and the individual may not even be aware of it since numbness and disorientation have settled over him. One of the symptoms of excessive internal heat is decreased awareness that anything is wrong.

Dr. David Costill says, "Numerous studies have reported rectal temperatures in excess of 105 degrees after races of 6-26.2 miles. Attempting to counterbalance such overheating, runners may incur large sweat losses (which) may total 6-10% of the body weight. Dehydration of these proportions severely limits subsequent sweating, places severe demands on circulation, reduces exercise capacity and exposes the runner to health hazards associated with hyperthermia (heat stroke, heat exhaustion, muscle cramps)."

This doesn't just happen with the unfit. On the worst days, no one is

safe. At the 1967 US Pan-American Games marathon trials, Costill observed that "many of the pre-race favorites failed to finish the race and several of the men demonstrated overt symptoms of heat stroke (no sweating, shivering, lack of orientation)." The temperature that day was a muggy 95, and the race started at mid-day.

Anyone could have predicted trouble there, but Costill says that recognizing a dangerous day isn't always so easy. "Even under moderate thermal conditions (e.g., 65-70 degrees, no cloud cover, relative humidity 49-55%), the risk of overheating is a serious threat to highly motivated distance runners." In other words, the day doesn't even have to feel hot at the start to be too hot later on.

Dr. Costill thinks, "For the health and safety of the athletes, definite governing limits should be placed on the environmental conditions of distance running competition."

Runner's World has published a list of guidelines for beating the heat. "Spelling out explicit limitations and bans on when races can and can't be run may be a bit extreme," says the author, "but setting down a few guidelines for race organizers would undoubtedly help them understand what runners *require* for fast, safe and satisfying racing."

HOT WEATHER RACING GUIDELINES

1. Realize the drastic toll that running can take, so you'll know why it's urgent to avoid it.

2. You can't order perfect weather conditions on a particular day, but you can improve your odds by studying the general climatic conditions of an area.

3. Shy away from periods when the temperature is likely to be above 60 degrees at race time.

4. Attempt to schedule long distance races (more than one hour in duration) in the "marathon season"—the cool months between September or October and April or May in most states.

5. Start races early. Nine a.m. would seem to be the latest suitable time, since even with that starting time many runners would still be on the course in mid-day heat in the longest events.

6. If adequate course lighting is available, thought may be given to running at night (pre-dawn or post-sunset) since this eliminates the sunshine problem and considerable heat.

7. If possible, provide a course with some shade.

8. Offer no less than one well-supplied aid station for every three miles of the race.

9. Be willing to pull from the course without hesitation any runner who's obviously in danger of heat-related collapse.

10. Make all officials thoroughly aware of first-aid measures in the event a runner collapses.

The article concludes, "These guidelines put the burden on the people who promote and organize long distance races. There's a good reason for this. As long as races are available, even if they're on the Mojave Desert at high noon in July, runners are going to attempt them. You can't keep them away. And if it's hot, the race will turn into a 'death march' with the remote danger of permanent injury or fatality, and the assurance of high dropout rates, slow times, increased suffering without a corresponding improvement in results. Most of us are in this game for the results, not to see how much suffering we can withstand."

Recently, steps have been taken to improve the lot of the suffering runner. Legislation before the United States AAU proposes that "(1) long distance runs held in warm climates should be started before 9 a.m. or after 5 p.m.; (2) *should not* be conducted when the temperature exceeds 85 degrees and the relative humidity exceeds 70%; (3) *shall not* be conducted when the temperature exceeds 100 degrees regardless of the humidity."

Also, there is almost no enforcement of the international rule that no one can drink before seven miles. And of course unlimited drinking means healthier races since fluid loss is the leading culprit in heat stress.

Heat related collapses still happen, though. And even if they aren't pleasant to consider or talk about, we have to do both. The serious problems are these: *heat exhaustion* and *heat stroke.*

Exhaustion is a stage leading to stroke. With heat exhaustion, the sufferer has a pale, clammy skin after the collapse. Treatment involves fluid-electrolyte replacement.

Heat stroke is far more critical. The skin is dry, red and quite hot. To treat, reduce body heat *immediately,* by any means available.

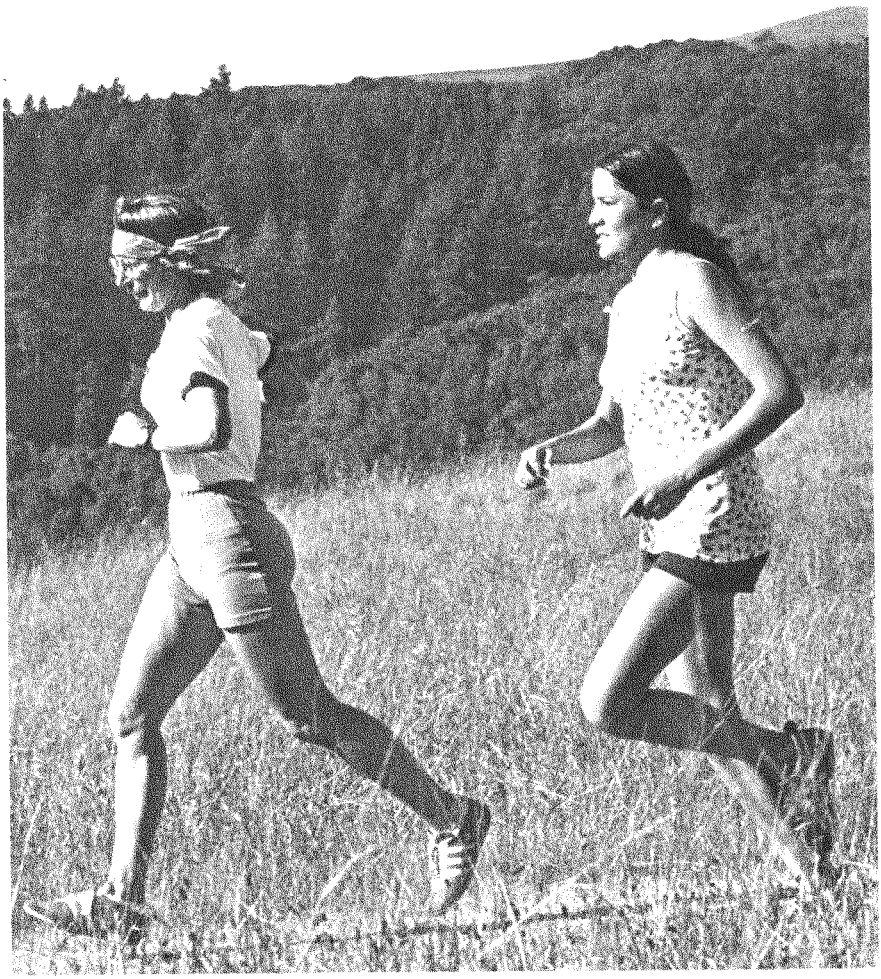
Dr. Gabe Mirkin writes, "Forget about giving the victim fluid by mouth. It is worthless. You are interested in cooling him immediately. His temperature may be 110. (Place the victim in the) shock position–legs up, head down. Evaporation is the key. Pour anything you can on the victim immediately (water, milk, Coke, Gatorade, etc.). Rub his skin vigorously to open up the surface blood vessels. Hose water on him. The best thing to do is to rub ice cubes all over his body. Get him out of the sun. Above all, keep pouring something wet on him. If the patient is not lucid and able to communicate with you intelligently, get him to a hospital as soon as possible."

If a runner suffers heat stroke, odds are between two and seven in 10 that he will die of brain damage, circulatory or kidney failure. This is the grim word from Drs. Thomas O'Donnell and George Clowes. They worked for a time at the Marine Corps training station at Parris Island, S.C., where heat collapses are common among recruits.

The doctors treated patients by (1) lowering body temperatures as quickly as possible by plunging the victim into "life-saving ice baths" and (2) replacing fluids with a mixture of water, salt and potassium, usually given intravenously. Using this system, they treated 39 heat stroke cases over a two-year period. Under normal circumstances, as many as 25-30 of these men might have died. None did.

There's a lesson here for people who organize and watch distance runs, and it is that they have to be ready to help those who have pushed beyond helping themselves.

"Most of us are in this game for the results, not to see how much suffering we can withstand. . ." (George Beinhorn photo)



FIRST WATER, THEN SALTS

If the warnings about the risks of running in hot weather are sounding repetitious, it's because these warnings take so long to get through to some people. These are the ones who still insist, "Water just before or during competition will give you cramps," or, "Drinking when you are overheated is asking for trouble."

Water and mixed drinks may in fact not go down easily with some individuals. But considering the alternatives pointed out in earlier articles, this kind of drinking may be a good habit to cultivate. The danger of *not* replacing water is far greater than any problem discomfort that drinks might cause.

As fluid is lost, the body temperature climbs. "Dehydration is a stressor on the system," writes exercise physiologist Dr. Alan Claremont, "since a dehydrated individual will exhibit a higher rectal temperature than in a hydrated state. When a runner loses weight through sweating, he increased the total amount of heat held by the body. As a result, his temperature may rise from 0.3 to 0.5 degrees (F) for each 1% loss of body weight."

As the temperature rises, efficiency decreases. Physiologists indicate that fluid losses above 2-3% of body weight push the temperature high enough to have a marked effect on running performance.

Dr. David Costill says, "When a man loses 2% or more of his body weight by sweating, his ability to perform prolonged, exhaustive exercises is drastically impaired."

South African Dr. C. H. Wyndham, an expert in heat responses, has found in his tests a close correlation between sweat loss and body temperature. He says that "up to a water deficit of about 3%, body temperature varied about 101 and 102 degrees. But with an increase in the water deficit above 3%, rectal temperature increased in proportion to the extent of the water deficit."

Water losses above 3% are critical, according to Wyndham. This amounts to 3-6 pounds in persons weighing 100-200 pounds (see accompanying chart).

THREE PERCENT WEIGHT LOSS

Pre-Run	Post-Run*	Pre-Run	Post-Run*
100 lbs.	97 lbs.	150 lbs.	145 lbs.
105 lbs.	102 lbs.	155 lbs.	150 lbs.
110 lbs.	107 lbs.	160 lbs.	155 lbs.
115 lbs.	112 lbs.	165 lbs.	160 lbs.
120 lbs.	116 lbs.	170 lbs.	165 lbs.
125 lbs.	121 lbs.	175 lbs.	170 lbs.
130 lbs.	126 lbs.	180 lbs.	175 lbs.
135 lbs.	131 lbs.	185 lbs.	180 lbs.
140 lbs.	136 lbs.	190 lbs.	184 lbs.
145 lbs.	141 lbs.	195 lbs.	189 lbs.

* Post-run weights including water replaced during the run, but with no drinks after finishing.

Yet it is common for long distance runners to lose twice that much, or more. David Costill has recorded fluid deficits of almost 10% after a marathon, and rectal temperatures above 105 degrees!

Some of this loss, and the subsequent temperature rise, can be avoided by drinking while running. Wyndham says, "The ideal regimen of water drinking is to take about 300 milliliters (half a pint, or a large cup) every 20 minutes or so. This should start right from the beginning of the race."

The doctor says runners should train themselves to drink early and often, even if they don't feel thirsty. David Costill has observed that when left to their own whims, runners don't drink enough. At the 1968 Olympic Trials, he found that marathoners lost an average of nine pounds but replaced only a half-pound of that. He has seen in his laboratory that by the time a runner wants his first drink, he may already have lost 2-3% body weight. Once this much is lost, this is all but impossible to replace during the run.

A runner of course can't stop to weigh himself in mid-run. But regular weight checks during hot spells are worthwhile protection against chronic dehydration. Costill advises regular weighing before and after each run, noting extreme variations from normal. Weight loss during the run (some may have been made up with en route drinks; don't take a post-run drink before weighing) shouldn't regularly total more than 3-6 pounds. All of this should be made up before the next day's run. If not, this is a signal that the body's water balance is out of whack. This imbalance should be corrected before it gets any worse.

Water, in turn, is balanced with elements called electrolytes in the body. Correcting imbalances also involves replacing sodium, postassium, etc. Water is the first priority, then salt (sodium-chloride) and potassium. Remember that. "Alone, salt and potassium are nothing," says Dr. George Sheehan. "In fact, salt without water does more harm than good." Too much salt, in the absence of water, creates more of an imbalance than existed previously.

The ideal solution is one which combines water and key electrolytes. Dr. Martin Eisman says the drink must include sodium, chlorine and potassium in specified amounts. He analyzed three commercial preparations—Sportade, Gatorade and Bike Half-Time Punch—and found that none of the three had even half the salt needed by an unacclimatized individual. Sportade was adequate in potassium, but the other two drinks were not.

Eisman found a far superior drink in tomato juice mixed half and half with water. Each drink of this solution provides about twice the recommended minimums of sodium and chlorine, and more than six times the needed amount of potasisum.

Whether a runner can tolerate the taste of tomato juice during a run is another question entirely. The message here, though, is that any drink is better than none. Some are simply better than others.

YOU'LL GET USED TO IT

Heat tolerance is largely an acquired trait. The cool logic of the scientist tells us, as Dr. George Sheehan does in his *Encyclopedia of Athletic Medicine*, "Ten days to two weeks of hot weather training should stimulate the body by: (1) improving circulation to the skin; (2) improving sensitivity and capacity of the sweating mechanism (begin sweating at a lower temperature); (3) reducing salt loss by the kidneys and sweat."

Ron Daws talks of adaptation in more personal and compelling terms. By all appearances, Daws is a natural heat runner. Twice he qualified for national teams on days when other, faster runners were left steaming beside the roads. Ron, who went to the Pan-American Games in 1968 and the Olympics in '68 as a marathoner, seems to have a unique capacity to tolerate hot weather. What else could explain this kind of running by a man from Minnesota, one of the coldest states in the country?

Daws has an explanation. He points out first that there's nothing special about him. He says he suffered as much as anyone until he learned a thing or two about heat. He tells of a race early in his career:

"At mid-day, nearly 200 already half-cooked runners had hit the melting and sticky streets of Yonkers (N.Y.). The temperature was edging toward the 96-degree mark, the high for the sun-scorched afternoon. The occasion was the combined 1964 Olympic Marathon Trial and the national AAU championship, and it was only such bait that lured so many runners onto the roads where the surface temperature simmered at 140.

"Two hours later and 18 miles into the race, my heat regulatory system failed, and I could no longer sense if it was hot or cold. I somehow kept moving through 25 miles, where I found myself in a respectable position of 10th. But the heat, sun and humidity had extracted their toll. Heat cramps infested my legs. I lurched for a telephone pole and embraced it for support..."

Daws finally finished in 3:25. The next several hours, he recalls, "were a fight for consciousness." He was hospitalized, released and readmitted after being found unconscious on the shower floor.

"That was my first encounter with racing in extreme heat," Daws says, and "I swore there would never be another. The fiasco might have ended there except for the enigmatic question that nagged at me. How had Buddy Edelen, training in chilly England, managed to spit in the eye of the sun and outdistance the entire field by over 20 minutes in an amazing 2:24?"

The answer, Daws learned, was simple: Edelen had trained wearing five layers of clothing, illustrating the truism of heat training. That is, *if you want to race well in heat, you must train in it. If the weather is cool during your preparation, you must create your own conditions of heat.*

From this lesson developed Ron Daws' "Pay Now, Fly Later" plan for heat adaptation. If race day was likely to be hot, he simulated that heat in training. Three years after his Yonkers collapse, on another day well into the 90s, Ron worked his way through the pack to make the Pan-Am team—"not because I was inherently the better runner but because on that particular day I was able to cope with the conditions."

THE DAWS "PAY NOW, FLY LATER" PLAN

1. If there is no chance that race conditions will be warm, there is no purpose in heat training. Special heat training is only needed when the race day is likely to be hotter than preparation days.

2. The most advantageous heat training is done in early spring, preparatory to important races which are likely to be held in hot weather. Opinions differ, but most knowledgeable physiologists agree that it takes from nine days to three weeks to acclimatize the body to this type of stress. I would recommend three weeks.

3. The real trick is not in knowing how and when to do it, but convincing yourself that it is important and then resisting the temptation to shed the clothing. Keep your sweats on to simulate hot weather.

4. If you decide to pay now, realize that on some days you will be miserable. If you are not, add more sweats because adaptation will not occur unless you undergo periodic stress work in fairly uncomfortable heat.

5. You can't heat train every day. Apparently, the body has difficulty fully replacing liquids and salts, and requires longer than 24 hours to recover. Day-after-day heat training will only wear you down mentally and physically.

6. To facilitate decent training at these times, drink plenty of liquids before and during the workout.

7. Three weeks before the big day, bundle up three or four days a week to suffer it out. On the other days, run comfortably, but with enough on so that you are not acutely cold. Your training should be similar to what you would normally do, but necessarily slower because of the extra clothing.

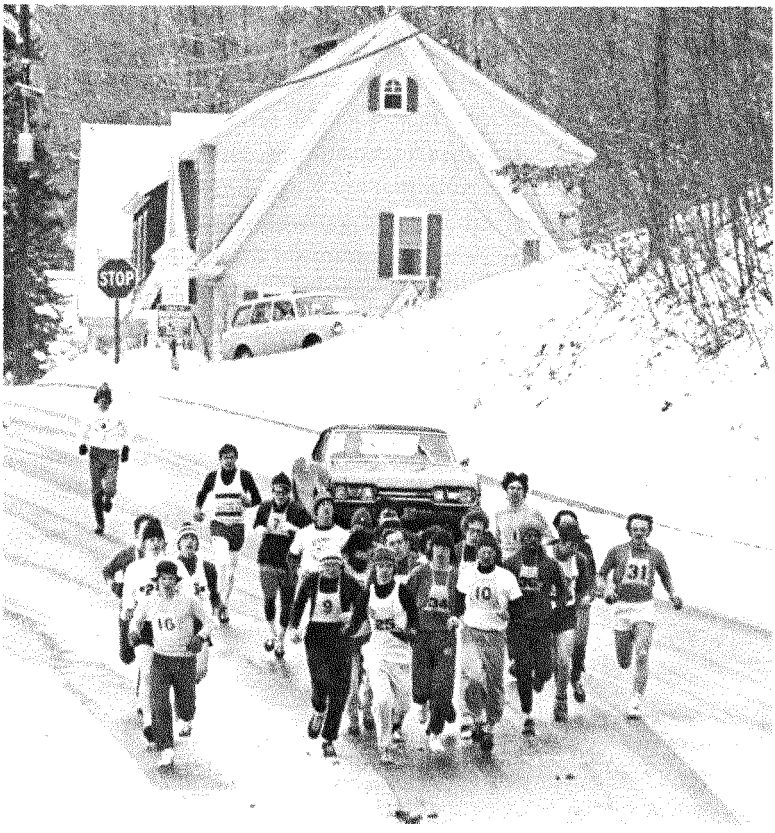
8. The last two or three days before the race, forget about heat training. Do not dehydrate or exhaust yourself.

9. What you wear during a hot, sun-drenched race is also critical. Stay away from dark colors. Wear white. Create your own shade by covering your shoulders. Keep the shirt wet. Wear a cap.

10. Keep your head when the gun goes off. Resign yourself to the fact that you can't run as fast, so don't go out like you are running to keep warm. Start out extra easy and let the rest of the pack melt itself into the pavement.

Chapter III

WHEN IT'S COLD



To race in New England in the winter usually means running through the snow. Note the variety of dress among these marathoners at a race in Brattleboro, Vermont.
(Robert George photo)

NOT SO BAD AS IT LOOKS

First impressions are too easy to misread. To a runner who hasn't experienced the ravages of heat, balmy summer afternoons look inviting. To one who hasn't worked up a sweat on a winter morning, the chill outside seems to warn, "Stay in bed." These impressions are deceptive.

Pat Lanin, who lives and runs year-round in Minnesota, says, "Successful winter running involves more common sense than courage, although the latter quality is probably most necessary when getting up will-power to turn the door knob, leaving a warm, comfortable building and immediately experiencing a temperature drop of 60-100 degrees."

Jim Sexton of Saskatchewan says of his winter runs, "I open the front door slowly, cautiously, hesitantly, as if I am scared of what I am going to encounter. I take the first breath. As the cold hits my lungs, I cough and gasp at the shock. I round the corner of the garage and force myself to face the wind."

The first shock is enough to send the strongest runner back inside. But if he persists, and if he is dressed for the cold, he finds that on the whole it is more comfortable, more exhilarating and probably safer than heat.

"The greatest problem in winter running," says Lanin, "is simply getting the door open when you're ready to leave. The feeling of satisfaction and accomplishment is tremendous when you know that you've met and surpassed the seemingly overwhelming challenge posed by trying to maintain a training program for track or long distance running outdoors during the winter months."

"I know," says Sexton, "that when spring and summer roll around I will be closer to winning for having run all winter."

For a runner—any kind of runner—to remain fit and/or competitive, he has to run all or most of each winter. Three- to five-month layoffs never kept anyone lean and sharp. There is no good reason why anyone should take this time off. Excuses of, "I don't have an indoor track to train on, so I can't run," and "I can't get out in the winter or I'll hurt my lungs," simply don't hold up.

That runners spend so much time worrying about the effects of cold and thinking up reasons not to go out in it, while having so little regard for heat is ironic—ironic because the dangers and discomforts of cold are greatly exaggerated and the threats of heat are very real.

A runner warms up quickly. We talked of that at great length in the last chapter. This can be a problem in summer. Compare it to turning on the furnace when you should be using the air conditioner. However, the internal heat generated during running is just what you need in winter. Once the furnace gets cooking, all but extreme cold with wetness and wind is tolerable—even pleasant in its briskness.

The running body responds better to cold than to heat. It warms up quickly when it's chilled, but cools slowly—if at all—when overheated. Physiologist Dr. Alan Claremont explains, "When the conservation of body heat is of paramount importance, cold responses are characterized by (1) constriction of skin surface blood vessels; (2) increased heat production by involuntary muscle contractions (shivering), and (3) redirection of blood from surface vessels to deep vessels.

"Man has the ability to protect himself from cold by bringing his semi-tropical environment with him. Surrounded by a micro-climate of warmth provided by adequate insulative clothing, he may enjoyably participate in cross-country skiing, running, winter camping, etc., that involves long-term exposure to the cold."

Because of the internal heat he generates, the runner's insulative layer of clothing doesn't even need to be a heavy one on most days. Light sweat pants or long johns, a turtle neck and nylon windbreaker, gloves or mittens and a stocking cap may be enough. If the sun is out and the day is still, he may strip away some of this protection as he runs. When dealing with cold, overdressing is more common than underdressing.

Cold itself is less of a problem than the complications that come with it: snow and ice which clog the roads and make them dangerous; darkness of short winter days which can cast a depressing pall over early morning and early evening workouts; wind which makes cold seem colder in much the same way that humidity makes heat seem hotter.

Major storms, months of darkness, and icy winds admittedly make life anything but easy for a wintertime runner. There are days here and there when runs must be cut short or cut out completely. But there is no justification for skipping winter running entirely. Runners certainly are no less durable than skiers, ice skaters and snowshoers who live for their days in the cold. Do the snow and ice people fret about respiratory infections or "frozen lungs"? Hardly. Yet one of the persistent myths blocking cold weather running is that the frost somehow will creep inside and mess up one's air passages.

German medical doctor Ernst van Aaken says just the opposite is true. "This slow heating of one's own inner oven strengthens the runner's resistance. If you change clothes immediately after running, there's no danger of catching cold."

Runners do catch cold in winter, van Aaken, says, but the cause is effort, not air temperature. "A mistake often made—especially among marathoners—is to believe that the most miles ought to be run in the rawest part of the year, in January. Runners doing this kind of training don't build their reserves but squander their capital to the point of depletion. Naturally, they catch cold easily."

Van Aaken advises, "During very cold weather, only run as many miles as you can while staying comfortably warm and reasonably dry. There should be no effort to force more miles out of yourself in winter than in summer."

Another old fear, the one about "freezing" or "frosting" a lung apparently has no basis in fact. Dr. Merritt Stiles, an authority on medical questions related to skiing (and author of *Skiing At Any Age*), writes, "Because of the warming effect of the upper air passages, I can conceive of no possibility of air cold enough to damage the lungs ever reaching them, no matter how strenuous the exertion. And I have never heard of cold air damaging the upper respiratory passages, for that matter, even though superficial frostbite of the skin is not uncommon in fast skiing in cold weather."

The face, ears and hands—in other words, the peripheral areas of the body which aren't hard at work in running—are in some danger of frostbite. Frostbitten skin is "cold, pale and firm-to-hard to the touch," according to Dr. George Sheehan. First aid steps are: "(1) rewarm quickly, but

don't use excessive heat; use water at about body temperature; (2) do not walk on or massage the frozen part; (3) do not rub with snow; (4) seek immediate medical treatment."

Frostbite and other cold-related injuries and illnesses are most likely to happen not when a person is running and warm but rather when he stops and cools too quickly and too much. For that reason, it is advisable that runs in winter be continuous and that runners get back inside as soon as they're finished. This is only common sense. And that's what Pat Lanin said at the start: "Successful winter running involves more common sense than courage."

WIND-CHILL READINGS

You can't really know how cold it is by reading the thermometer or listening to the weather report. It isn't enough to know the temperature. It merely says how cold the day *is*. The wind determines how cold the day *feels*.

Wind speed makes as much difference in the comfort level of winter as humidity does in summer. A day at 20-above can feel as cold as one at 20-below, depending entirely on how hard the wind is blowing. That 20-below day can be relatively safe for running or extremely hazardous, depending again on wind speed and direction.

Dr. Charles Eagan, now at Colorado State University, devised an "Equivalent Chill Temperature" chart while stationed with the military in Alaska. It gives temperatures based on how cold they feel in the wind. For instance, a 40-degree temperature coupled with a 40-mile-per-hour wind has the same chilling effect as calm 10-degree weather.

Eagan's chart shows that temperatures down to 20 degrees below zero pose "little danger" to runners who are properly dressed. There is "increasing danger" in wind-chilled temperatures down to 70-below, and "great danger" lower than minus-70.

Not many days in anyone's year are going to drop low enough to put them in great danger. This requires an actual temperature of at least 15-below (with a 35-m.p.h. wind).

Dr. Eagan says, "I never had to give up running four or five miles a day at noon hours in Fairbanks, although the temperature was below minus-40 on occasion. The greatest risk in running in cold weather is freezing of the extremities—fingers, toes, ears, nose or even lips. Therefore, proper clothing is essential. There is no risk of freezing the lungs, although this is commonly believed."

Proper clothing is particularly essential at the "increasing danger" temperatures, Eagan points out, because exposed flesh may begin to freeze within a minute. The freezing time shortens as the wind-chill reading drops.

Wind *direction* is as important as wind speed to a winter runner. Anyone who has run in the cold knows the feeling. You're running along nicely, enjoying yourself, even working up a sweat, and you say, "There's nothing to this. It's 10-below and I don't even notice it." Then you turn back toward home and an icy blast takes your breath away. It freezes the sweat and turns the return trip into a numbing grind.

If you're running an out-and-back course, Minnesotan Pat Lanin recommends, "*Always* run into the wind at the beginning of the workout and with the wind on the way back. Running with the wind allows the body to build up heat and become sweated down due to lack of cooling effect from the wind. So once this is done, the results of having to run into the wind, after having all of your clothing soaked in perspiration, can be disastrous.

"I came home in a state of near-shock one evening when I disregarded an 18-mile-per-hour tailwind over the first seven miles of a 14-mile run on a January evening when the temperature was a neat 12-below. Believe me, that was the toughest seven miles of my life."

EQUIVALENT CHILL TEMPERATURES

Wind (MPH)	Temperature (Farenheit)																				
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60
	Equivalent Chill Temperature																				
5	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-65	-70
10	30	20	15	10	5	0	-10	-15	-20	-25	-35	-40	-45	-50	-60	-65	-70	-75	-80	-90	-95
15	25	15	10	0	-5	-10	-20	-25	-30	-40	-45	-50	-60	-65	-70	-80	-85	-90	-100	-105	-110
20	20	10	5	0	-10	-15	-25	-30	-35	-45	-50	-60	-65	-75	-80	-85	-95	-100	-110	-115	-120
25	15	10	0	-5	-15	-20	-30	-35	-45	-50	-60	-65	-75	-80	-90	-95	-105	-110	-120	-125	-135
30	10	5	0	-10	-20	-25	-30	-40	-50	-55	-65	-70	-80	-85	-95	-100	-105	-115	-120	-130	-140
35	10	5	-5	-10	-20	-25	-35	-40	-50	-60	-65	-75	-80	-90	-100	-105	-115	-120	-130	-135	-145
40*	10	0	-5	-15	-20	-30	-35	-45	-55	-60	-70	-75	-85	-95	-100	-110	-115	-125	-130	-140	-150

Little Danger

Increasing Danger (Flesh may freeze within one minute)

Great Danger (Flesh may freeze within 30 seconds)

*Winds above 40 m.p.h. have little additional effect.

Remember, a runner is moving into the wind, creating more of a chill factor than a standing object would experience. Lanin's wind speed was about 25 m.p.h. He was running in a wind-chill temperature of minus-60 or so, and was approaching "great danger."

On days like this, he says, "It's a good idea to outline your intended running circuit before you leave home, so your survivors know where to look in case you're overdue on your intended time schedule."

DRESSING FOR THE COLD

"During the Second World War," Dr. George Sheehan writes, "gunners on American bombers complained bitterly about frozen fingers, toes and ears. With typical military efficiency, the socks, gloves and hats were insulated. The gunners still sometimes came back frostbitten, but did not compalin.

"The lesson to be learned is that one feels cold most in the fingers, ears and toes. Accordingly, to protect against winter's cold, runners should wear heavy gloves (or mittens) and hats, and keep their feet dry. It is amazing how much cold can be handled with a flimsy sweat suit as long as the ears, hands and toes are warm."

The adage among runners is "warm at the extremities, warm all over," or vice versa. Hands, head and feet need the most protection. The legs and torso need the least. Frank Shorter, for instance, once won the national cross-country championship on a frosty day wearing a thin, long-sleeved shirt on top and panty hose on the bottom. The runners at the University of Oregon wear only long underwear or tights on their legs all winter, favoring these over bulky sweat pants because they allow more freedom of movement and leave no cold air space between the cloth and the legs.

When the temperature is around the freezing mark, the day is dry and fairly calm, runners tend to wear too much clothing rather than too little. Overdressed runners put themselves in the curious position of risking dehydration and overheating in freezing weather.

Start with a stocking cap, gloves or mittens, light socks and a thin covering over the rest of the body. This should be enough for wind-chill temperatures down to perhaps 20 degrees. Below that, the running wardrobe grows. But how? Ask the advice of runners who've been to the extremes and survived. Few places in the world have colder mid-winter weather than central Canada and the adjacent US border states, yet a few hardy individuals run through the worst of it.

Dr. J. Karr Taylor lives in Cut Bank, Mont. "Twenty to 30 degrees below is routine here," he says, "and even colder days are not unusual. As striking perhaps as the cold are the winds. Forty to 60-m.p.h. velocities are frequently experienced."

When Dr. Taylor runs in this weather, he dresses according to the wind-chill chart. We don't have color printing, so our chart doesn't show it, but the "little danger" level normally is coded green, "increasing danger" is yellow, and "great danger" is red. Taylor says he uses the following guidelines:

- "In the green, briefs, top and bottom thermal underwear, wool socks, nylon warmup pants, hooded sweatshirt and mittens (or even less).
- "In the milder yellow, add a thermal shirt and knit pullover mask."
- "In the nastier yellow, add thermal bottoms (this pair need not be full length), a second pair of mittens or gloves, and a leather mask."

He apparently doesn't run when the temperature drops into the red zone. His personal record is a mere minus-72. Jim Sexton of Saskatchewan reports he has run to a low of 125 degrees below zero (wind-chilled, of course; the record low actual temperature for North America is about 80 below).


29

"To give you an idea of how much the runner's body can take," Sexton writes, "I can relate an experience I went through in January 1972. Sometime around noon, disregarding the pleas of my parents and assorted other kin, I went out and ran 7½ miles when the temperature was 125 below. I didn't really feel cold—just slow. Of course, I was wearing five layers of clothing and then some."

Sexton lists dressing in layers as the first rule for running in extreme cold. "Avoid heavy, bulky garments," he says. "Use several layers of light-weight clothing." As many as five may be needed. If not, they can be stripped off one at a time. Pat Lanin, whose advice Sexton is echoing here, lists the layers:

"The layer closest to the skin should be absorbent and not irritating. The second layer should be insulating; a light wool sweater or long underwear is excellent. If the conditions are not too bitter, a good tightly-woven windbreaker could top off this combination and be serviceable down to zero degrees if the wind is still or very light.

"Colder conditions or high winds will necessitate additional layers. Under the most severe cold and wind conditions, I will use a light-weight dacron quilted undershirt in addition to three or four layers of other light garments."

Multi-layering applies to the upper body. No more than two layers should be required for the legs. "A single good pair of double-knit nylon or wool combination warmup pants will give good results down to 10 or 15 degrees below zero," says Lanin. Sexton adds, "A pair of wool or nylon warmup pants and long underwear are more than adequare for all types of weather. I do not wear more than one pair of pants unless the weather gets below minus-100 with the wind-chill factor."

A head covering made of wool is recommended. "Wool," says Sexton, "because of its ability to absorb great amounts of moisture without losing its insulating properties, should be used in as many places as possible when collecting a winter uniform." He and Lanin both advise runners to get a wool ski mask with no hole for the mouth.

Lanin says, "The effect of the wool covering over the mouth is amazing. Even in the coldest weather I've been in (48 below zero, actual temperature), the air I breathed was still well above freezing. You get so used to breathing 'warm' air, you find yourself wearing the mask even when the temperature gets up over 20 above zero."

Mittens, both men say, are superior to gloves for warming the hands. Sexton notes, "Probably the best mittens are those made of leather with a high cuff." Lanin says, "When the weather is really raunchy, I will put a plastic bag over each mitten."

Even on snowy days, a runner can stay quite comfortable in only a light long-sleeved shirt, stocking cap and gloves. The legs need little or no protection when temperatures are near freezing, as is the case in this race in Vermont. (Roger George photo)

One pair of wool socks will do under most conditions. The idea is to keep the feet dry and insulated. Lanin says, "On many occasions, I have returned home after running in snow to find snow packed in my shoes, but I was none the worse for wear from cold feet."

A coach from Michigan, Jim Murray, adds, "No runner, once he has discovered Baggies (plastic food wrapping bags), will be without them. They are not used for carrying a mid-run snack, but to keep the feet comfortable on cold and wet days. A Baggy put over socks keeps the feet warm by keeping body heat in, and snow and cold out."

A runner who insulates himself properly before going out can handle almost any insult winter throws at him.

RUNNING AT 50-BELOW

BY HYLKE VAN DER WAL

Van Der Wal, a Canadian internationalist in track and former national record holder in the steeplechase, lives in an isolated area of the country—beside Hudson Bay at 56 degrees latitude. He writes of his second winter of running there, the winter of 1973-74.

So far this year, the overnight low has dropped to 53 degrees below zero here, with the day's "high" climbing to minus-40. This cold weather more often than not is accompanied by ice, fog, high humidity and/or wind. Yet I hold to my belief that environmental elements such as these can be partially controlled by the manner in which we react to them and sensibly adapt a careful program which results in a training gain.

It is obvious to me that before long running races will be held at temperatures of 40- and 50-below, the same as skiing and snow-shoeing races are held in these conditions now. To the novice, this may appear foolhardy or a mockery of the gods, but it is certainly quite feasible and not some romantic myth of Man vs. Environment.

When I moved to northern Ontario, I had serious questions about my ability to adapt. Could I pre-condition myself for such low temperatures? How long would it take to acclimatize to the cold or would I adapt at all? Would long slow distance work allow me to keep my sharpness and edge, or would such sloth-like aerobic dawdling be of no significance whatsoever? If I trained anaerobically, how strenuous should my workouts get? Would fast distance, fartlek, short distance, sprints, speed or ultra-long repetitions be best?

To help plan my winter program, I wrote to many exercise physiologists and sports medicine experts. But they couldn't tell me much more than what a certain lab experiment with a certain number of beagles had shown, or that mine should be a plausible experiment but other than that... "Sorry, we help to five-above or near zero. After that, you've got to be kidding!" Little research apparently has been done on cold stresses, and energy and oxygen uptake changes, and thermal differences from one type of environment to the other as they affect distance runners.

I knew from personal experience that the heat produced by continuous exercise of, say, a 2-3-hour period may drastically affect the thermal equilibrium while running in the cold unless extreme care is taken and continued liquids (often in the form of fresh snow) are consumed at very regular intervals. A greater number of pit-stops to urinate become a definite necessity at such low temperatures.

Some sports journals suggest thermal underwear for distance runners. I am unable to wear this because I sweat too profusely. Consequently, I decided to use two pairs of sweat pants, plus two pairs of woolen socks and a regular pair of training shoes with lots of grip for deep snow drifts and ice, a Norwegian fish-netted vest, another thermal vest for the chest, two pairs of gloves, a woolen cap and a hood. Only on a minus-52 day (with a 10-m.p.h. wind for a wind-chill reading of more than 80-below) have I had to add a ski mask.

This is the second winter here. My adjustment has been good, and my training has become quite conscientious in that I do not want to miss as many days as I did last winter. I now feel that with proper clothing, warmups and adequate daylight, almost anyone who desires can train at much colder temperatures than heretofore believed possible. When I have properly warmed up and done some calisthenics inside before running, there have been no problems at all. The greatest problem I have encountered so far has been trying to put additional pants, coat, socks and gloves on and drying off near a fire after my straight runs of 10-miles or more. To fail to bundle up, light a fire or dry off after such runs, or to take in no liquids and food, could mean serious frostbite or death at these temperatures.

I have noticed that on very cold days, pulse rates rise quickly during fast interval workouts. Invariably, it is too cold to have too long a rest period, so the heart-reviving workouts are short, swift and sweet. Yet faster training can be done if care is taken at all times to warm up and warm down properly.

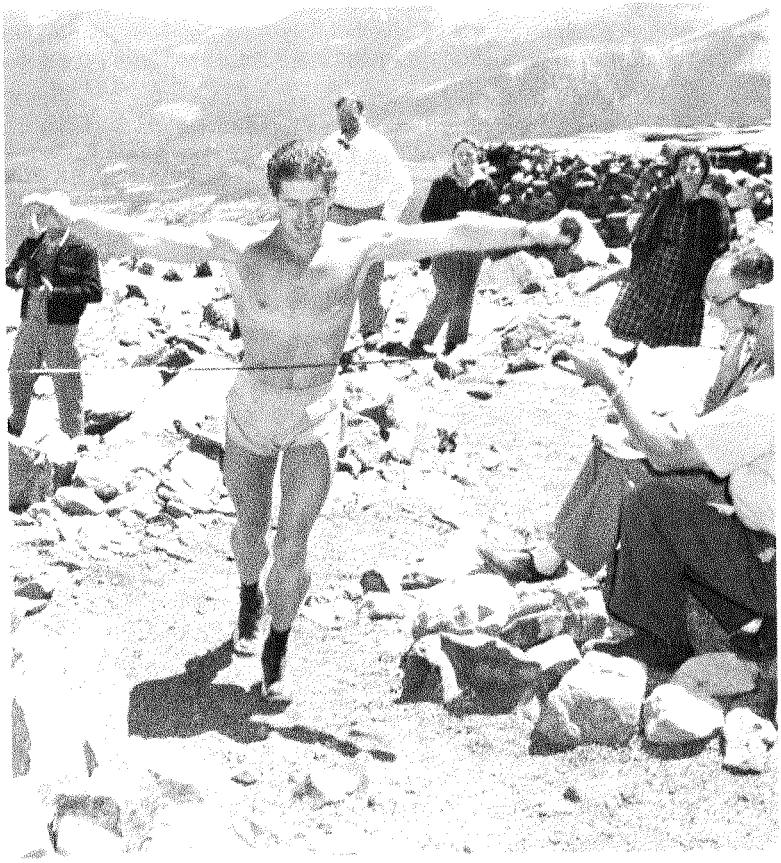
It appears then that cold weather adaptation is possible at a much faster rate than has been believed possible. And we may be able to adapt to cold and retain the adaptation for greater periods of time given repetitive periods of training in such regions. This may account for my greater adjustment to regular training this year after experiencing last winter's temperatures.

Personal observation seems to indicate to me this season that regularity of training sessions is the key—having the motivation to go out and do it. Without a doubt, this has to keep condition at a higher level than if one retires for half a year or more because the temperature doesn't get above freezing.

Common sense and consistent evaluation of the training is necessary anywhere, but this is doubly true for training in super-cold environment. You have to run *with* the cold environment, not *against* it. Any training that is done in the cold can save much agony later on, when the real running season is upon you. Any running, any shape retained or gained during the cold months need not be reclaimed later in the season when a runner should be sharpening up.

Chapter IV

UP IN THE AIR



The highest marathon in the world is the one which climbs Pike's Peak in Colorado. It goes from 7000 to 14,000 feet—then back down. Oxygen is at a premium all the way. Here, Monte Wolford reaches the summit in the 1956 race.

THE INVISIBLE FORCE

You can't hold it, see it or smell it, yet the air is far from an innocent force in a runner's life. We've already spent almost half of this book telling what happens to running when the air is warm or chilled excessively. This chapter tells about stormy, thin or dirty air.

While you can't hold, see or smell the air, you can feel its movement, measure its results and taste the impurities it carries. Even when temperatures are ideal, wind, high altitude and air pollution can have marked effects on running. In the first two instances, the effects can be good or bad—depending on your circumstances. With pollution, however, there are no redeeming features.

• **Wind**—It can be a blessing or a curse. If you're a sprinter, you love it because it may help your times. But if you run a lap or more on the track or face the wind on distance courses, it isn't so friendly. You never make up as much with the wind at your back as you lose while fighting it. In the summer, a headwind is a welcome cooler. But in winter, it hits with an icy blast.

The wind is thought to be so helpful to sprinters and hurdlers that officials have put a limit on it. No, they don't hold back the wind by decree. But they do hold back consideration of records in races through 220 yards which have more than 2.0 meters per second (4.473 miles per hour) wind assistance.

These are largely matters affecting performance. Other wind-related storm conditions threaten health—or even life itself. The lightning and violent winds of thunderstorms can catch runners out in the open unprotected. The "whiteouts" of blizzards and blowing snow can cause runners to lose their bearings on streets they think they know.

• **Altitude**—As elevation above sea level increases, the air "thins." That is, it carries less oxygen and has less air pressure or resistance. The thin air works to the advantage of runners who don't need a lot of oxygen.

At the 1968 Olympics, in 7500-foot Mexico City, every men's and women's world record from 100 to 800 meters was either broken or tied. The men's 100, 200 and 400 marks still stand, and are among the oldest in track. Yet the winning Mexico City times at 5000 and 10,000 meters, and the marathon were considerably slower than the world bests, and most of the medals went to life-long altitude residents.

A valuable lesson came from those Games, though. Distance athletes learned they could improve their sea-level times by training for extended periods in the mountains.

• **Pollution**—The air in some cities has grown so filthy that on bad days doctors warn residents to avoid all unnecessary outdoor activity. A Los Angeles area coach has noted that his runners' times decline noticeably on smoggy days. Road runners report that they often return home feeling dizzy and nauseous after training on busy streets.

A runner who gulps air in at many times the rate of sedentary people has that much more need for clean, oxygen-rich fuel. And the sad truth is that most runners are breathing in less good air per gulp than at any time in the history of mankind. It's sure to have effects, both immediate and long-term.

THE TWO FACES OF WIND

When dealing with windy weather, there are several different sets of problems to consider. The first is defining just what "windy" is.

Sprinters and hurdlers have the only objective answer as it applies to runners. The wind behind can't be more than 2.0 meters per second or 4.473 miles per hour during a race. It it is, records can't count.

How brisk is a 4.437-m.p.h. wind? Not very? Meterologists think so little of it, they only call it a "light breeze." Without a wind gauge, it's impossible to distinguish between a legal and an illegal wind. The only way a sprint or hurdle mark can be considered legimate is when a wind gauge operates throughout the race. The human senses aren't sensitive enough to detect slight differences in winds this light.

One way we can get rough estimates of the wind's force is to use the "Beaufort Wind Scale." It divides winds into nine categories, according to their effects on smoke, trees, flags, telephone wires, etc. (See the accompanying chart.) Knowing the names and signs, though, doesn't do a runner a lot of good unless he knows the accompanying effects on him:

- How much does the wind help sprinters when they have it behind them?
- How much does it hurt other runners when they buck it?
- How much risk is involved when wind blows up to storm proportions?

Trailing winds don't seem to help sprint and hurdle times as much as officials and athletes like to think. Otherwise, all the fastest wind-aided times would be significantly faster than the legal world records. Hundreds of races have been run under gale conditions. And yet the only windy mark faster than the accepted one is John Carlos' 9.0 for 100 yards. The assistance on that one wasn't more than a "gentle breeze."

A strong tailwind might have a disruptive effect on a runner's form which neutralizes any gain he might have gotten from the push. This seems particularly true in the high hurdles, where a wind may cause a runner to arrive at the barriers too soon. But this is speculation.

Dr. Everett Phillips has tested results to back up his view that a trailing wind isn't much help—at least to sprinters on the highest levels. Phillips tested 10 sprinters at the University of Rochester, five from the varsity team and the rest junior varisty sprinters. They ran 50-meter time trials through the university's wind tunnel, and were timed with an electronic device accurate to one-10,000th of a second. Phillips ran the sprinters with wind assistance ranging from 1.0 to 6.0 meters per second (2.23 to 13.42 miles per hour). The results:

- **Average times**—"Statistically, there was no difference between the trials performed at 1.0, 2.0, 3.0, 4.0, 5.0 and 6.0 m.p.s. and those at 0.0 m.p.s. The raw data, however, did indicate faster trials for the varsity group at 1.0 and 2.0 than 0.0 wind conditions, and for the junior varsity group at 1.0, 3.0 and 6.0 m.p.s."

- **Fastest times**—"Again, no statistical differences between performances at 1.0, 2.0, 3.0, 4.0, 5.0 and 6.0 m.p.s. and those at 0.0. The raw data again

indicated faster times for varsity trials at 1.0 and 2.0 m.p.s. and faster junior varsity trials at 1.0 and 3.0 m.p.s."

Dr. Phillips concludes, "Slower runners are affected more than faster runners, and the winds possibly must exceed 6.0 m.p.s. before competition of national and world class would be affected." As proof of his claim that slower runners get more help, he offers these statistics: only 1.5% of the faster runners' trials were better at 3-6 meters per second wind than when the wind was below one m.p.s. But 20% of the junior varsity times were faster in "illegal" wind conditions.

A runner probably never is helped as much by a tailwind as he is hurt by headwind. Tailwinds don't conserve power to the extent that headwinds demand it.

"Power," explains engineer C. L. Livingston, "is the quality you get by multiplying a force acting on an object by the velocity of the object in the direction the force is acting. The units of power are foot-pounds per second or, where there is lots of it, horsepower. One horsepower is equal to 550 ft.-lbs./sec. A well-conditioned man can produce at most about half a horsepower for several minutes."

While running into a wind, Livingston points out, you must consider not only the wind speed but your own. If, for instance, you're going at six minutes per mile (10 m.p.h.) into a 10 m.p.h. wind, the wind speed relative to you is 20 m.p.h.

"For a 10 m.p.h. running speed," Livingston says, "the power you expend with no wind is 32 ft.-lbs./sec. To maintain this speed in a 10-m.p.h. headwind, you must expend 127 ft.-lbs./sec.—four times as much power. You are only traveling at six-minute mile pace, but you're putting out sub-four minute power!" (See accompanying chart.)

BEAUFORT WIND SCALE

Velocity (m.p.h.)	Description in Forecasts	Noticeable Effects
below 1	Calm	Smoke rises vertically.
1-3	Light air	Direction shown by smoke drift, but not by vanes.
4-7	Light breeze	Wind felt on face; leaves rustle; wind vanes move.
8-12	Gentle breeze	Leaves and twigs in motion; wind extends a light flag.
13-18	Moderate breeze	Wind raises dust and loose pages, moves small branches
19-24	Fresh breeze	Small trees in leaf begin to sway.
25-31	Strong breeze	Large branches begin to move; telephone wires whistle.
32-38	Moderate gale	Whole trees in motion.
39-46	Fresh gale	Twigs break off; progress generally impeded.

Headwinds are a performance-related problem. They only get into the area of health and safety when cold weather is involved and "wind-chill" temperatures dip well below zero. (This is discussed in detail in chapter three.) Thunderstorms and wind-blown snow can also put an unwary runner in a life-threatening predicament.

In vast areas of the United States, thunderstorms with their lightning occur several times a month on the average. These storms often blow up quickly and catch the runner in the open. If this happens, the National Oceanic and Atmospheric Administration advises:

1. *Get away from water.*

2. *Seek shelter in buildings.* If no buildings are available, your best protection is a cave, ditch or canyon.

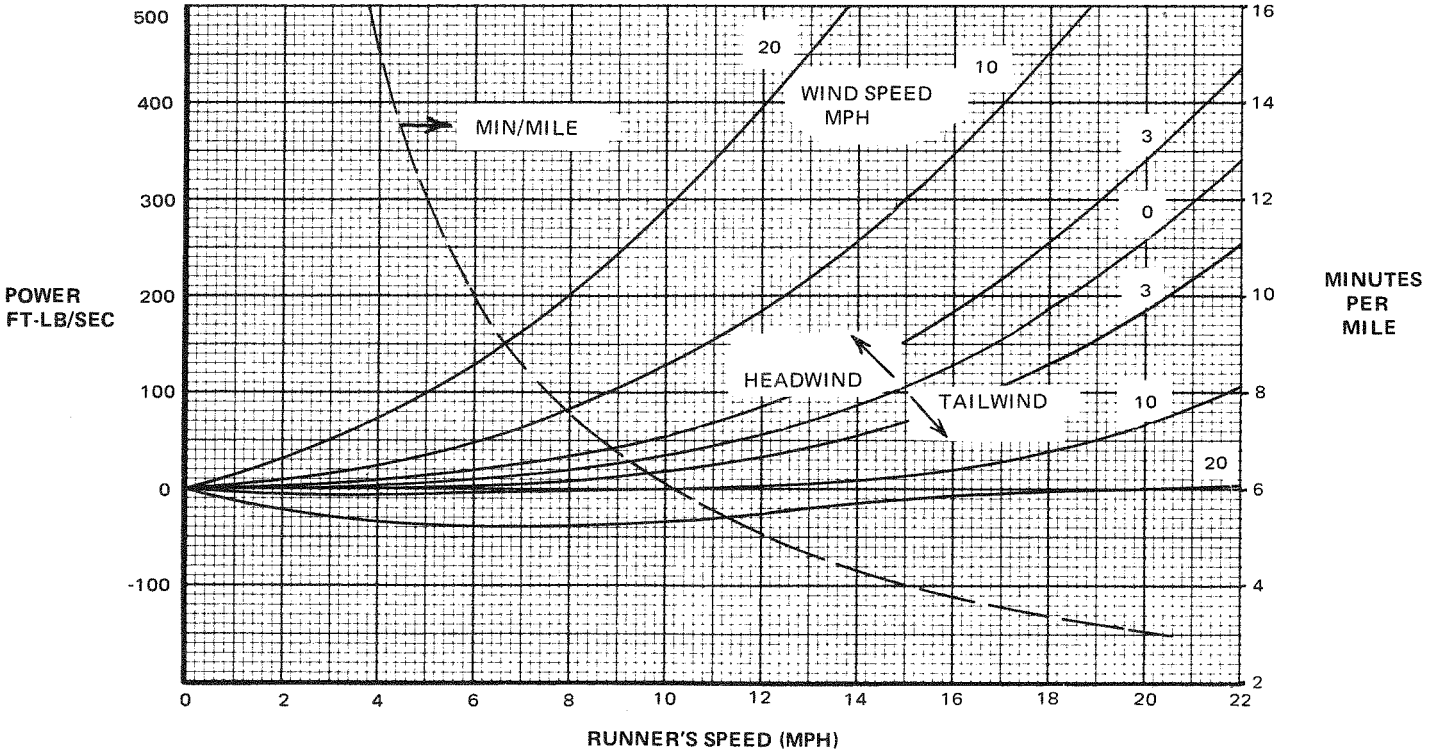
3. *When there is no shelter, avoid the highest object in the area.* If only isolated trees are nearby, your best protection is to crouch in the open, keeping twice as far from isolated trees as the trees are high.

4. *Avoid hilltops, open spaces, wire fences, metal clotheslines, exposed shed and any electrically conductive elevated object.*

5. *When you feel an electric charge–if your hair stands on end or your skin tingles–lightning may be about to strike you. Drop to the ground immediately.*

Thunderstorms are largely a warm-weather phenomenon. The danger in winter is blizzards. Snow doesn't even have to be falling for "blizzard" conditions to exist, as blowing snow can be really deadly. In the northern plains, and mountains, farmers often tie ropes between their houses and their barns to guide them in blinding snow. They hear periodically of people dying from exposure 50 feet from their stalled cars.

Advice for snowstorms: If you can't see, stay inside. If you're caught out in a blizzard, find the nearest warm shelter and wait the storm out. Winter roads are no place to be when you can't see.



EFFECT OF WIND AND RUNNING SPEED ON POWER EXPENDITURE.

EFFECTS OF ALTITUDE

What a difference an Olympiad makes.

In Mexico City, 1968, distance athletes were bemoaning the fact that they had to compete at an elevation of 7500 feet. Worse, they had to race against people with the built-in advantage of a lifetime at altitude. A month or two at a mountain training camp couldn't bring the lowlanders even.

It was called the "Unfair Olympics." Africans, all but one of the high-altitude natives, won every race 1500 meters and up. The 1500, not coincidentally, is where thin air begins having a detrimental effect on performance. It's still being argued whether or not the Kenyans and Ethiopians would have done so well had the '68 Olympics been held somewhere else. They undoubtedly did have an advantage, yet prior and later performances by many of these men—notably Kip Keino and Mamo Wolde—showed they would have been hard to beat anywhere. Their altitude training was a benefit to them wherever they ran.

This was the lesson of Mexico City—that while thin air may be something to fear in racing, it's a valuable aid to training. Runners training at altitudes of a mile or more above sea level adapt to their short oxygen supply. When they get back down where oxygen levels are normal, they find they're "super-compensated." They run faster, easier.

Four years after the Mexico City Games, distance athletes again were heading for the mountains to train. But this time it was by choice, not necessity. Every winner from 1500 meters up at Munich—Pekka Vasala, Lyudmila Bragina, Lasse Viren, Kip Keino, Frank Shorter—had spent some of the summer of '72 at altitude. Shorter, along with US teammates Jack Bacheler and Jeff Galloway, trained 8000 feet up in the Colorado Rockies.

Before talking any more about the benefits of altitude, let's back up and outline what happens to a runner there. Dr. George Sheehan writes, "There has been shown to be little or no effect when unacclimatized athletes run at elevations up to 3000 feet. Above that, altitude becomes increasingly more of a factor for these reasons:

- *"Low atmospheric oxygen pressure* diminishes the athlete's maximum intake, and therefore influences sustained running pace.
- *"Low air density* decreases the air resistance and makes it possible to run faster at distances where oxygen intake isn't a major consideration. (Two minutes is the approximate dividing line where altitude quits helping and begins to hurt performance.)
- *"Dry air* contributes to dehydration and dryness in the nose and throat.
- *"Solar radiation*, along with dry air, contributes to heat stress in long distance running."

M. H. M. Arnold, a Briton who has done physiological research high in the Andes, says when you fly to a high city, "You will feel quite uncomfortable. You will pant at the slightest exertion and feel desperately tired—but you will sleep badly. You will quite likely feel sick and have a headache. You

will feel depressed and irritable. All of these symptoms are due simply to shortage of oxygen."

Dr. Sheehan recommends one or two courses for a lowland runner forced to race at altitude: (1) race immediately after arrival, or (2) train there several weeks to acclimatize. Arnold says three things happen as a person adapts:

- "First, you breathe more deeply, making the best use of what oxygen there is.
- "Second, your 'red-cell count'—the number of red corpuscles in your blood—increases, making it possible for the blood to carry more oxygen.
- "Third, the acidity of your blood can change slightly, increasing the affinity for oxygen of the hemoglobin in your red corpuscles."

The beauty of this is, these effects don't disappear immediately on return to sea level. They last, giving a better than normal capacity to transport and use oxygen. If runners use this adaptation wisely, they can turn it into a racing advantage.

E. C. Frederick, author of *The Running Body* and editor of *Running* magazine, lives above 7000 feet in Arizona. He offers these altitude training hints:

"How high? Recommendations vary as to what altitude is best. An altitude at 5000 feet is considered minimal for the effects to be significant. Practical considerations make 10,000 feet about the highest one can live in any sort of comfort and maintain high mileage. Since it is obvious that the higher you go the more dramatic are the effects, athletes should seek training sites as close to 10,000 feet as possible. The majority of altitude-trained runners, however, live between 5000 and 8000 feet.

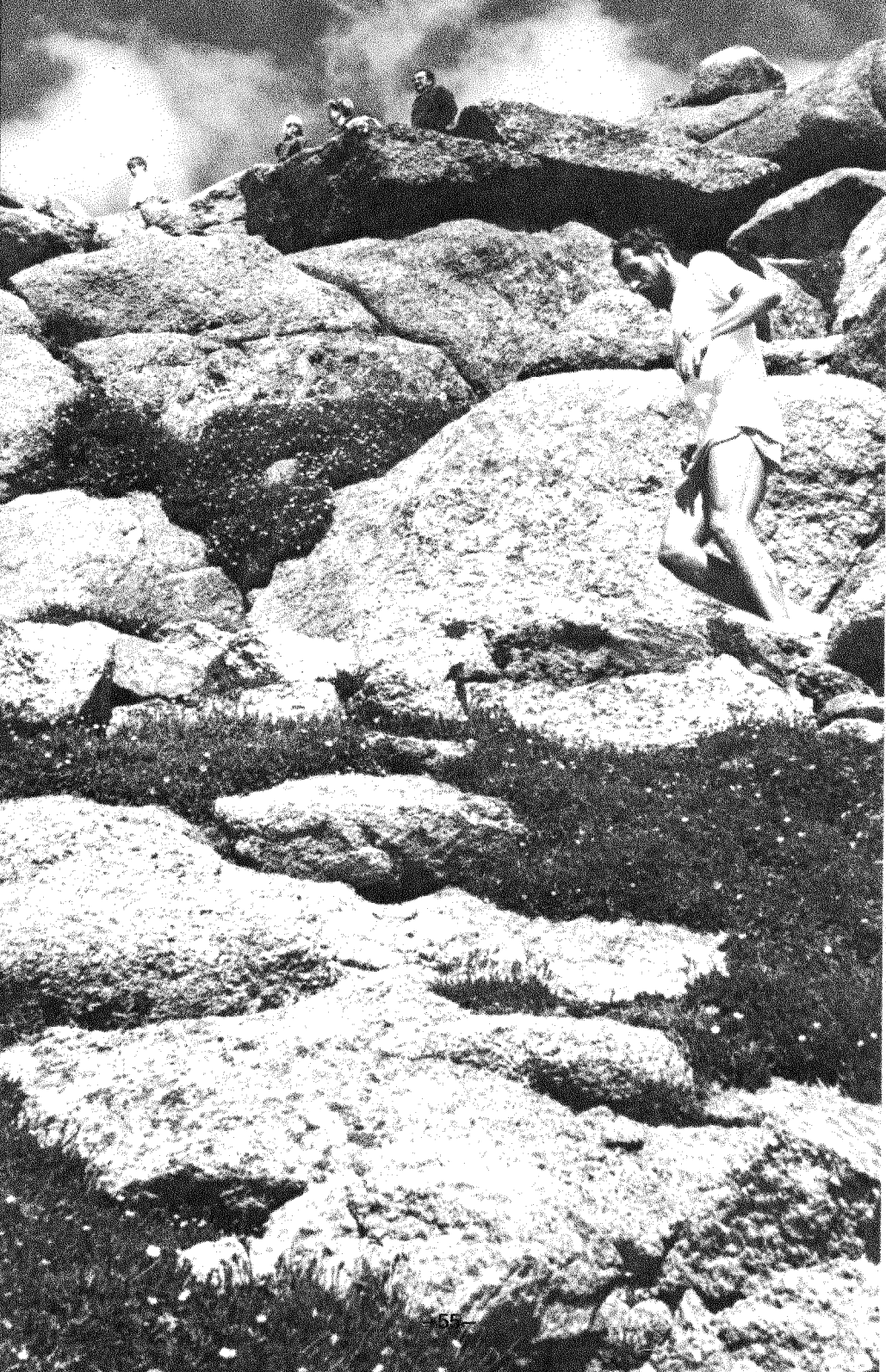
"How long? It takes at least 4-6 weeks to acclimatize to moderate altitude. This should be considered the minimum stay. However, many of the adaptations will take as long as a year to maximize. So it is advisable to stay as long as possible.

"How far? It is advisable to cut back training mileage as much as 50% upon arrival from sea level. This may not seem necessary during the first few days, but within the week it will become obvious. Mileage can then be gradually increased to former levels at a rate dependent on the progress of your adaptation.

"Racing at sea level. It is advisable to either race within 24 hours of arrival at sea level or to train for 10 days to two weeks at sea level before racing. You will slowly lose your altitude adaptation over many weeks, but it will take as long as a year to return to pre-altitude levels. The 10-day to two-week period will not significantly detract from gains at altitude."

When the races are at altitude, though, runners have to realize they can never go as fast (at races longer than two minutes) as they could if the same

The rocky descent of Pike's Peak, a marathon race that climbs to 14,000 feet plus. (Richard Kiefer photo)



race were at sea level. Even thoroughly altitude-trained athletes were 15-25 seconds per mile slower than world record pace in the three longest races at Mexico City. This fact works a hardship on runners who have to do most of their racing up high. They get little chance to set records there, and find it hard—if not impossible—to reach qualifying standards for major meets.

Jerry Quiller, distance coach at the University of Colorado, surveyed 18 coaches and top athletes from the Rocky Mountain area for their opinions on the difference altitude makes. Quiller reports that the following amounts of time should be added to qualifying standards to compensate for the thinner air:

Race (time)	3000-3999'	4000-4999'	5000-5999'	6000-6999'	7000-7999'	8000-
mile (4:07)	2 sec.	3 sec.	4 sec.	5 sec.	6 sec.	7 sec.
2 miles & steeple (8:50)	4 sec.	7 sec.	10 sec.	13 sec.	16 sec.	19 sec.
3 miles (14:00)	8 sec.	13 sec.	18 sec.	23 sec.	28 sec.	35 sec.
6 miles (29:30)	20 sec.	30 sec.	40 sec.	50 sec.	60 sec.	70 sec.

Once the runners are in the big meets at or near sea level, the wisdom of their months of labored breathing becomes clear.

AIR POLLUTION DANGERS

Respected doctors have advanced a somewhat frightening theory: that runners who insist on exercising on days of heaviest pollution may be losing more from breathing the poisoned air than they are gaining from the exercise.

Dr. Stephen Ayres of New York's St. Vincent's Hospital, author of a number of reports on the effects of dirty air, is a supporter of running. Yet he points out, "One obvious potential problem is that the exercising individual ventilates at many times his control (resting) level. The total load of inhaled pollutants must be similarly increased and thus the overall body burden augmented."

Ayres' view is that "the value of a regular exercise program is so great that it most certainly outweighs any theoretic harm produced by environmental pollutants, particularly in the normal individual. I would recommend that people continue to run, but perhaps not push themselves to the same levels of exertion on smoggy days."

Runners apparently can't exert themselves as much on smoggy days even if they try. Brice Hammerstein, a club coach in the southern California smog basin, made an informal study of results on days with varying degrees of pollution. The ozone readings ranged from 0.0 parts per million (clean air) to 0.53 parts (well above "unhealthy" level).

On the clear day, all four girls either ran personal best times or were quite close to them. Results were about the same when the ozone reading was 0.02. When it climbed to 0.14, times fell off by as much as nine seconds.

"The most significant meet," says Hammerstein, "was the one occurring on the day with the 0.53 ozone count. All four girls were in their best condition during this period. Not one of them ran within 11 seconds of her previous best... However, all four girls placed in their usual spots in relation to other runners. After the race, several girls complained of shallow breathing, raw throats, dry noses, or any combination of these."

For general air pollution to pose a serious health hazard to an otherwise healthy athlete, it has to be breathed in not just for the relatively short span of a run or race, but for days, weeks, months. New York City air resources commissioner Fred Hart, a runner, says the long-term effects of air pollution are subtle. "They tend to be erosive on the system, some showing up years later. But they affect us all."

Most city-dwelling runners live day in, day out with one of two types of polluted air. The American Medical Association lists them as:

- "The occurrence of sulfur oxides in combination with solid particulate matter. Such occurrence is common in the temperate zone industrial cities of the United States and several other countries.
- "The other form of pollution is associated with a photochemical smog, such as has stigmatized Los Angeles particularly, but may also be found in other areas where there is considerable sunlight and motor vehicle use."

"The latter is the type of smog that slowed Brice Hammerstein's runners. New York's official Fred Hart says, "Studies made in Los Angeles show that milers running on days designated as 'unhealthy' ran 5-10 seconds slower

than their usual time. But even more important, constant exposure to air filled with pollutants is dangerous to everyone's health."

The most immediate, obvious and avoidable danger is carbon monoxide. While we can't get completely away from traces of it, we can avoid the heaviest concentrations simply by staying out of traffic.

Carbon monoxide is a colorless, odorless killer when the concentration is heavy enough. It takes over red blood cells and won't let oxygen ride along. Runners aren't likely to die from carbon monoxide poisoning, but it can make them feel terrible.

Rick Trujillo of Colorado normally runs on mountain trials, in the thin, pure air. But he writes, "One day a friend and I went on a 15-mile run along an easily-traveled two-way road with cars passing every 5-10 seconds. One mile from the finish, he stopped. I was forced to stop also slightly later due to sudden difficulty in breathing.

"The attack on our breathing came suddenly and seemingly without warning. After stopping, breathing became normal. But any attempt to run or even walk immediately brought back the panting and feeling of suffocation. It took 20-30 minutes for our breathing to become normal enough for us to finish that last mile. The feeling of shortness of breath lasted several hours after the run.

Shortness of breath. Dizziness. Nausea. These are all symptoms of carbon monoxide overdoses. Concentrations of 10-15 parts per million in the air are considered acceptable under clean air guidelines. Exposure to 27 p.p.m. for an hour can result in partial loss of vision, impairment of judgment, and other symptoms. The internal combustion engine pumps out exhaust with tens

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NEW YORK CITY AIR POLLUTION INDEX

Air Quality	Sulfur Dioxide (parts/million)	Smokeshade (units)	Carbon Monoxide (parts/million)	Oxidants (parts/million)
Good	0.00 to 0.03	0.0 to 0.3	0 to 10	0.00
Acceptable	0.04 to 0.06	0.4 to 0.6	11 to 15	0.01 to 0.02
Unsatisfactory	0.07 to 0.10	0.7 to 1.0	16 to 20	0.03 to 0.06
Unhealthy	0.11 to 0.40	1.1 to 5.0	21 to 60	0.07 to 0.15

above the upper figures is the "Danger Level"

Daily newspapers in most metropolitan areas carry air quality statistics similar to New York's. Of the pollutants, sulfur dioxide is an invisible irritant gas produced almost entirely by burning fuel to heat buildings and to generate electric power. Smokeshade (sometimes called "particulate") consists of the fine particles suspended in the air that come almost equally from heating, incineration of refuse and a combination of power generation, industry and transportation. Nitrogen dioxide is an irritant gas formed from the nitrogen in the air during a high temperature combustion process, its primary toxic effect being on the lungs. Oxidants are eye-irritating chemical compounds formed by the action of strong sunlight on nitrogen oxides and hydrocarbons (evaporated solvents and gasoline).

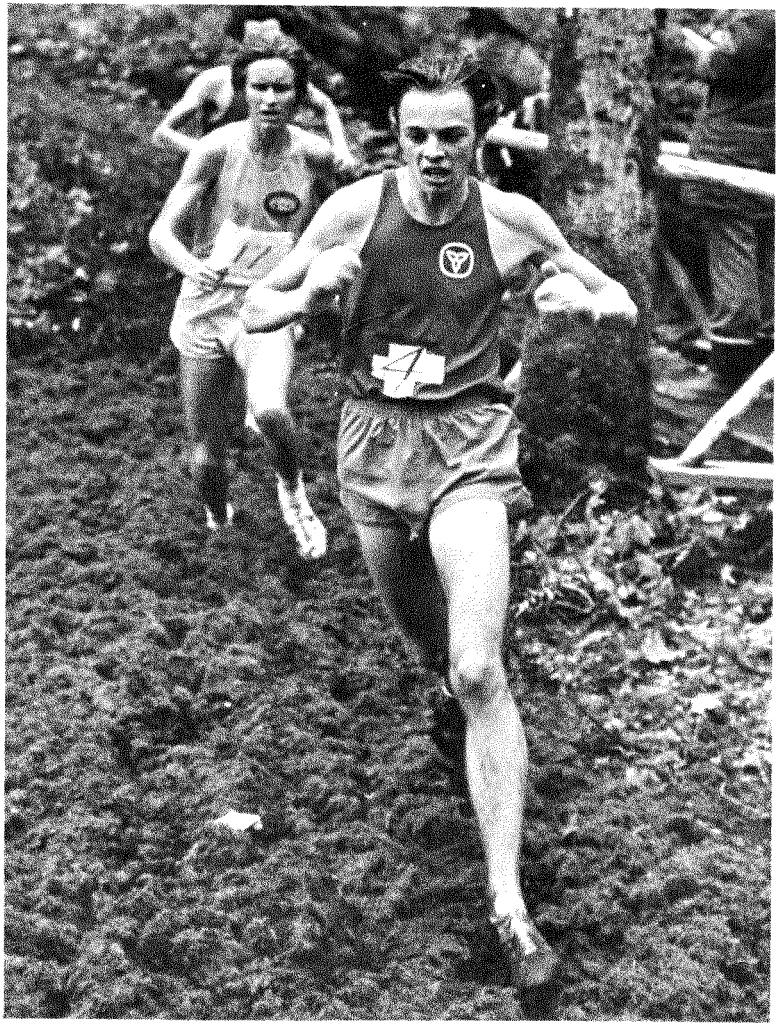
of *thousands* of parts per million. The greatest portion of this is quickly dispersed. Yet it is not uncommon for readings next to busy streets to be 50-100 p.p.m. or more. If the fumes don't get to a runner in these conditions, the cars themselves might (partial loss of vision, impaired judgment, remember?)

To be safe, advises Fred Hart, runners who train alongside highways should stay at least 30-50 feet from the traffic. Another study indicates that concentrated carbon monoxide fumes reach out 65 feet or more on either side.

Since the automobile itself is an even bigger threat than the noxious fumes it belches out, the reasons for seeking out traffic-free running courses are all the more compelling.

Chapter V

DOWN TO EARTH



No one gets down to earth more than cross-country runners on a muddy day. (Bill Herriot photo)

A RUNNER'S "CAMELOT"

BY JOHN CHRISTIAN

Christian is employed with the Hennepin County Park Reserve District near Minneapolis-St. Paul. In that capacity, he lives in unspoiled parkland which all runners dream of but few get to experience every day.

Many who lived in my county during the early 1900s remember its numerous unspoiled lakes and streams, acres and acres of virgin forest, open prairies and abundance of birds, deer, foxes and other wildlife. Those of us who do not remember can only imagine its pages of colorful history gone by. Every day, I live a page of Minnesota's history in a secluded wilderness I call "Camelot"—a 2000-acre park reserve about a marathon from downtown Minneapolis. Share with me the joys of going back in time to the way it was not so long ago.

As usual, my clock radio disturbs the peace of the night's sleep with its lively wakeup music and the newsman's seemingly muddled sounding voice. And, also as usual too, I turn over and rationalize sleeping one more song, and lie back to catch the weather before tossing the covers aside. It's a ritual with me to peek outside my bedroom window and, between the radio forecast and my keen window-weather observation, decide what to wear on my daily morning run in "Camelot."

Feeling slightly stiff, I jog out to the wooded trail behind my house while the sun pushes its rose-colored face above the spring horizon. The mist is rising over the hills. Somehow, the magnificent white clouds overhead, the smell of morning dew on the trees and the flowers and the freshness of early morning air gives me a feeling of supreme freedom. This is my great escape into a special world of my own.

Suddenly, I hear a screeching cry from above. Stumbling slightly trying to run and look skyward at the same time, I see a red-tailed hawk soaring freely above. He is a large bird and glides effortlessly while using the air currents to perfection as he slowly stalls and dips in circling his prey. His shrill cry lets me know I am in his territory.

The hill to Lake Ridge Trail is quite taxing, but I struggle up and sight the deep blue lake waters beyond. Ignoring the strained ache and muscles tightening in my legs from the climb, I slowly jog and marvel at the lake's clear beauty and unspoiled shorelines. Somewhere in my run along Lake Ridge Trail, the over-water vistas between the cottonwoods and green ash always remind me the total lake is owned by everyone and will remain so for all generations to enjoy. Hopefully, future men will respect the preservation decisions of today.

Often, in early mornings or late evenings, I run on the sandy shores and hear the jump of a northern or perhaps a bass. My reflexes are sometimes fast enough to glimpse its tail, but more likely only a ripple of small waves circling from the still waters. Today, the mood of the lake is gentle and peaceful as its rolling waves wash calmly on the shore. A seagull is searching for food and makes several unsuccessful dives before scooping up his reward.

From a distance, a great blue heron wades in the shallow water, fishing

for his food. Soon he too disappears and is next sighted above the treetops with his identifiable slow and majestic wing beat, long legs trailing behind.

After a mile or so, the rolling trail meanders away from the lakeshore and my quickened downhill pace carries me near a small marshy pond. The sudden sight of Canadian geese, mallards, wood ducks and a pair of large trumpeter swans brings me to a near standstill with my legs mechanically going through slow jump-rope motions. As I turn away, five or six mallards overhead set their wings and with necks outstretched, large webbed feet spread in front, land smoothly with hardly any splash at all.

I think of this as my private running world—a remote world, a place where I escape from the familiar sights and sounds of everyday life. I leave all people and problems behind while absorbing the solitude and tranquility of nature's beauty. I am alone with myself, but feel unity with the world around me. My personal problems of the day and world affairs shrink in a forest of trees, lakes and meadows, and the openness and awareness with the great earth. I feel a special closeness to the natural wonders and realize more clearly my niche in this complex web of life.

My run is peaceful and quiet. I hear the rhythmic pace of morning dew squishing in my shoes, chatter of squirrels, spring songs of chickadees and meadowlarks, and at time, an interrupted tattoo of a woodpecker at work.

Suddenly, I see it! I'm stopped in my tracks by the sight and try my best as I can to soften my deep breathing and still my pounding heart to a silence. There they are—five white-tail deer, frozen like stone statues, proud heads erect and noses gently sampling the air at my strange and unexpected intrusion in their world. What a thrilling and awe-inspiring sight! It sends chills up my spine. I move slightly. The five bound off in two or three quick leaps and are hidden for good—probably watching me and my amazement. It is then I realize I'm never alone on my runs.

My trails winds around a few open meadows, and while dodging a tree stump I end up in a briar patch. I mumble a few choice adjectives while scratching my legs and picking burs off my socks and jersey.

Without realizing my increased tempo, I reach a tunneled canopy of trees, once an old railroad bed, abandoned now to horseback riders and cross-country skiers. About a mile along this regular path, a small lake reveals the beauty of its framed picture. The secluded lake trail is through thick underbrush of ragweed, thistle and populated by hundreds of woodticks. My heart jumps an extra beat as a pheasant springs up in front of me and honks out its familiar alarm.

From previous visits, I knew of a cleared area leading to the lake marked by a strategically placed large branch. I spot my branch, and after modestly glancing around, strip off my shoes, shorts and jersey and plunge in the clear, chill waters.

Cross-country runners from the Twin Cities area use John Christian's "Camelot" as a race course. (Robert Grove photo)

The overhwelming sensation of the cold water over my hot and sweaty body is greatly welcome. My muscles completely relax and say thanks for this relief. I lie on my back simply floating while gazing around at the serene, living panorama surrounding me. I feel the power of a supreme being for such grandeur, its unique scenes and a spiritual way of experiencing the real meaning of living.

My running is more than preparation of an important race or a season of races. It is now a way of life with me. My daily communing with wilderness makes me more sensitive to its beauty, aware of the peace within myself, appreciative of the joy of living and feeling much closer to a spiritual, natural world in my struggle to be a real person. I know better the gentle touch of the forest, the blessings of a sudden spring rain, the sweet smell of trees, flowers and greening grass, and that special silence of a softly blowing wind.

SURFACES AND TERRAINS

Popular opinion among runners is this: the automobile is the root of all evil. They of course own cars and run on roads that wouldn't exist if there weren't cars. Yet runners see the automobile as their enemy.

It isn't surprising that they feel this way. To the vulnerable runner, the car is a fast, noisy, smelly, dangerous bully which controls the land through brute strength, size and force of numbers. It fouls the air with its fumes. It demands and gets a smooth, hard, level surface under its wheels.

To the runner, the car is a tyrant and he feels he's a prisoner in its asphalt and concrete jungle. There seems to be no place he can run to avoid running among the cars on their terms. Their terms are roads which have been smoothed, hardened and leveled in the name of speed and convenience.

Podiatrists tell us that man's feet and legs weren't meant to run on this kind of surface. The hardness is part of the problem, but so too is the smoothness. The theory is that the feet and legs were designed to bend and roll and twist with ever-changing terrain. That way they stay strong and balanced. But when surfaces are perfectly smooth—as asphalt and concrete are—every step is like every other. The feet and legs don't get the workout they should. And at the same time, they're absorbing a terrible pounding because feet don't roll over the roads the way car tires do.

So what is the cost of this? It's impossible to calculate exactly, but it's high. The most obvious way to measure effects of hard surfaces is in injury statistics. But injuries happen for a lot of reasons besides where we do our running. Then there's the problem of defining what is "hard." A sun-baked dirt path can be harder than a warm all-weather track. Snow covered concrete can be softer than a frozen playing field.

In general, though, asphalt and concrete are hardest, and "natural" surfaces (dirt and grass) are softest. The theory among runners is that the more one runs on the former, the more likely he is to get hurt. Is this true?

Runner's World surveyed its reader-runners in 1973. One set of questions asked about serious running-related injuries. "Serious" injuries were those requiring a month or more of recuperation. Another question asked where they did their running—in percentages of asphalt-concrete vs. dirt-grass. Fifteen hundred runners answered the questionnaire. In a sample this large, such variables as how much, how often and how fast they ran, how long they'd been running, and whether or not they race were balanced out.

The overall results of the survey showed that nearly one runner in two had suffered a serious injury. And it appeared that road runners had far more injuries than dirt-grass runners. This, however, was because there were far more road runners. Nearly a third of them did all their running there, and the great majority of the others spent at least half of their time on the roads.

When the numbers are reduced to percentages, a far different picture emerges. It shows that surface alone has no significance in the incidence of injuries. Runners who don't touch hard surfaces get hurt at a rate of 42%. Those who use nothing but hard surfaces get hurt at a rate of 46%.

INJURY RATES

% of Running on asphalt-concrete	% of runners in survey	% of runners seriously hurt
0-9%	5%	42%
10-19%	5%	44%
20-29%	5%	49%
30-39%	5%	47%
40-49%	6%	45%
50-59%	9%	44%
60-69%	8%	41%
70-79%	13%	39%
80-89%	13%	50%
90-100%	32%	46%

But a few more points should be made here, if only for the sake of you auto haters:

- Whatever the reasons, the injury rates are too high. Odds of 50-50 aren't good for any surface.
- Even if hard surfaces don't cause any more serious injuries, they do seem to cause more minor aches and pains (which can lead to serious complications) with less provocation than do soft surfaces.
- And who can claim that it is more pleasing to compete with traffic on a highway than to run through a park or along a forest path?

The soft places are worth seeking out for the head as much as for the feet.

Roads made for cars avoid the steepest hills as much as possible. After all, hills slow the car down and reduce its gas mileage. They do much the same with runners—both slowing them and using more energy at the same time.

"Hilly terrain," writes Dr. David Costill, "will significantly impair a runner's performance." Any runner knows that. But Costill goes on to quote findings that may not be so obvious. He says we never make going downhill what we lose going up.

Costill's test subjects climbed a 6% grade—a hill rising only six feet in 100—at eight-minute mile pace. He reports they required 35% more energy than for the same distance on the flat. But while running down the same grade at the same speed, they only reduced their effort by 24%. The net loss of energy was 11% for a moderate hill at moderate pace. The gap increases as hills steepen, effort increases, or as fatigue builds with repeated ascents.

Hills are hard, often slow work, but not necessarily work to be avoided. A runner can't fully appreciate the flats until he has climbed to the peaks. He can't coast until he has worked his way up.

HILL AND TRAIL RUNNING

BY KENNETH YOUNG

Do you measure hills by how long they are or by how high they climb? As a "flatlander," I used to measure hills by length. Since moving to Colorado, I've learned to measure hills by their height. If the climb is less than 30 feet, it isn't a hill. It's only a bump, a slight unevenness in the terrain. If its incline is less than one foot of climb in 20 feet, it isn't a hill. It's level.

Definition of Hills: Hills may be classified as "steep" if their average incline is more than one foot climb in five feet (1:5). It is doubtful that anyone can run up a steep hill in aerobic steady-state. In other words, such an incline eventually produces an oxygen debt which will limit performance. It is possible to run hills not classified as steep without going into oxygen debt. For example, the first hill up Pike's Peak climbs from 7500 to 9500 feet in roughly three miles, for an incline of about 1:8. This hill can be run aerobically.

Steep hills are considered "short" if they can be run to the top without incurring an oxygen debt which limits performance. From my experience, hills of less than 80-100 feet high are short. The one I do repeats on is a 100-foot, 1:3 hill. I've yet to run this hill without incurring an oxygen debt similar to that following a hard 440 interval. Another hill, only 60 feet high, 1:5, is actually fun to run up, despite being at the end of my trail courses. A 200-foot, 2:7 hill on my rough trail course is so tough that my legs are nearly numb by the top.

You can't just look at a hill and guess its incline. A hill always seems steeper than it really is. Lydiard recommends a half-mile long, 1:3 hill for running down. No way! Try running fast down a real 1:3 hill and you'll kill yourself. In lieu of a good topographic map (see descriptions later in this chapter), the following guidelines are useful. A hill too steep to run down without continual and pronounced effort to check speed has an incline steeper than 1:5. A hill that can be run down flat-out is not steeper than 1:10.

Why Run Trails? Now that it is understood what a hill is and is not, let me expound a bit on why I have come to prefer trail and hill training to road and track training. Bear in mind that I used to dread hills.

By running on trails, you can get away from cars with their pollution and rude drivers. Similarly, to a large degree, you can get away from dogs. Hikers, as a class of people, seem more sympathetic to runners than the general types one encounters. Perhaps this results from watching a runner actually run up a hill the hiker finds hard enough to walk up. A case in point occurred when a couple of friends and I went out running my "easy" trail. Bob and I were chugging up a 100-foot, 2:9 hill and passed a hiker who had stopped to rest halfway up. Charles, who was lagging back a bit, said the hiker just stood there with his mouth open, speechless. Of course, the slob crowd does tend to frequent the easy trails close to civilization, so I recommend the better hiking trails farther away.

Trail and hill running provides virtually any type of training that can be found on roads or tracks, and does so in a far more interesting format. I find

interval training tolerable if I don't have to do much of it. On the other hand, I lack the discipline necessary to make fartlek training work. I find that trail/hill running provides the enforced work/rest rhythm of interval training with the variability found in fartlek training. With a variety of trails to choose from, I can vary the structure of the workout. Actually, my trails each have so much variety that they aren't boring, even after running them some 30-40 times each for a few months.

I have two trails which I run frequently, an "easy" nine-mile out-and-back course with 1250 feet of total climb, and a "rough" 10½-mile "keyhole" (out-loop-back) course with 2100 feet of total climb. Total climb is simply the sum of all uphill stretches (bumps less than 30 feet not counted) and is a measure of the difficulty of the course.

The "easy" course is undulating, running parallel to the front range, traversing several ridges. This course provides the alternating work/rest of interval training with work stretches ranging from 15 seconds to four minutes in duration. The four-minute stretch is a 380-foot, 1:8 hill, and other hills provide work stretches of varying duration and intensity.

The "rough" course runs up a canyon, climbs a ridge and then comes back down the canyon, climbing from 6100 to 7600 feet in three miles. The "up" stretch has inclines ranging from 1:3 to 1:15, including a 200-foot, 2:7 hill. The uphill stretch provides a fairly long run at maximal aerobic steady-state. Running the long, down-stretch helps develop good leg speed. Of course, the long up-and-down stretches form a good training base for tackling Pike's Peak.

For a more formalized interval workout, every couple weeks I run repeats on the 100-foot, 1:3 hill. The hill is just high enough to produce a large oxygen debt (especially at 6200-feet elevation) without too much lactic acid buildup so that the hill can be repeated a number of times. I usually run 14-16 repeats and on occasion have done 20 reps. A proper hill for repeat work should be carefully chosen, with your own capabilities in mind. For me, a hill less than 80 feet high does not produce the large oxygen debt and hills much higher than 100 feet produce too much lactic acid. The average 1:3 incline forces high knee action and pronounced arm action. The hill undulates with some stretches approaching a 1:2 incline.

A repeat hill should be chosen keeping in mind factors such as footing, hill height and incline and a return path. Good footing is essential to insure against slipping which can result in pulls of muscle or tendon. Hard-packed dirt and well-buried rocks give best footing. The incline should vary from very steep (2:5) for good knee action to 1:4 for recovery of momentum. A less steep return path is desirable for relaxation between reps, especially since it is not wise to jog down a 1:3 incline while tired.

Another advantage to trail and hill running is in injury prevention. You ask, how can running on surfaces where a misstep can mean a twisted ankle or a slip can pull a muscle, reduce injuries? The irregular surfaces, changes in incline, uphill and downhill running all exercise a wider variety of muscles than flat running does. This tends to counter the imbalance between muscle sets that is believed instrumental in producing injuries in runners. Once proper trail techniques are mastered, chances of injury are probably less than one encounters running cross-country on grass.

There are disadvantages to running trails above and beyond the obvious ones of access. However, few runners who do have access to good trail courses take advantage of such training, due largely to an unwarranted fear of injury. Trail courses can't be run well when wet or under snow—especially the good, rough courses. This limits the training opportunities during winter. Although the dog problem is greatly reduced, I find myself developing an intense dislike for horses and the people who ride them on "my" trials. Not only do the horses leave their droppings on the trail, but they tear up the trails as well. Occasionally, I encounter riders on the trail, which is also a hassle (horses are a lot bigger than dogs and trails are narrow). I avoid the problem by running my rough trail which is too rough for horses. Here the only problem is cows.

You may question whether this type of training is capable of improving flat racing performances when done to the virtual exclusion of flat training. For several months, I did more than 50% of my training on trails such as I've described. In addition, another 35% of my training was done on hills. For flat work, I usually fit in a race every 2-3 weeks. I ran within 30 seconds of my sea level best 10 miles at 5300 feet elevation, my best 30-kilo by a minute at low altitude and my fastest marathon by more than three minutes.

Hill Running Techniques: In order to experience the benefits of this type of training, one must develop proper hill and trail running techniques. In addition, one must develop muscles for up-and-downhill running.

There is a vast difference between running hills on paved roads and running them on trails or dirt roads. Running uphill on a paved road uses fewer muscles to do the same work since the surface is regular and the incline is fairly constant. On a dirt road, the incline is less regular and footing becomes a consideration. Running uphill on trails frequently requires a jumping action to find footing and is usually associated with many changes in incline, all of which serve to employ more (i.e., different) muscles to run up the hill. Using more muscles distributes the load, making it easier to run uphill, provided the additional muscles being used are accustomed to this action.

Running downhill on dirt surfaces is in fact easier than running downhill on pavement—if one employs the proper technique. The braking action necessary to run down a hill steeper than 1:10 (but less steep than 1:5) can be provided by slippage on a dirt surface. Simply make first contact with the toe and skid while allowing the heel to make contact and finish the braking action. With practice, one can run downhill with relatively little energy expenditure. On pavement, this skidding action is not possible and it becomes necessary to expend energy simply to keep from going too fast.

The proper technique to run up hills depends on the steepness and height of the hill and the type of terrain being run over. For a gently rolling course with level stretches, it is possible to maintain a relatively constant effort. This is obviously the fastest way to cover a given distance. However, on a course which I would classify as hilly (average grade is greater than 1:2), a constant effort is not possible. Here, downhills become rests and uphills require effort, much like fartlek running. Short, steep hills are usually run with pronounced arm action and high knee action, driving strongly up and over the hill. Short hills with less than 1:5 incline may be negotiated with a normal running stride but with increased power.

Hills higher than say 80-100 feet must be run as economically as possible, especially if they are also steep. Experience tells you what the maximum effort possible is without going into oxygen debt. I've taken several runners on my "easy" trail course. Runners who attempt to match my pace up the 380-foot, 1:8 hill usually conk out around 150-180 feet and have to walk the rest of the hill. Charles, a more conservative runner, lets experience guide him and after a few trails now runs to the top at his pace. The moral is simple: maintain an aerobic steady-state while running up long–i.e., high–hills. If you go into oxygen debt too far from the top, you've had it. Long and steep hills will produce large oxygen debts and little can be done to make them easier or less painful. Perhaps the main thing is not to let them psyche you out.

On a hilly course, you can afford to run at a significantly higher effort going up hills since you can also "rest" going downhill at near maximum speed by employing proper downhill technique. Similarly, there are proper techniques for running uphill. Steep hills require you to run on your toes since they are too steep to allow the extension of the achilles tendon necessary to plant the heel on the surface. Running on the toes means that another joint position, the ankle/foot, needs to be supported, requiring additional muscular contraction. Thus, if the incline is not too steep, the most economical running form maintains heel contact. Clearly the steepness of the incline which you can negotiate while maintaining heel contact is determined by how "stretchable" your achilles tendon is. Proper hill training can lengthen the achilles tendon, strengthening it and allowing steeper inclines to be run with heel contact and thereby to be run more economically.

Trail Running Techniques: Trail running requires both concentration and technique. If you think trail running involves looking around at the scenery, forget it! Only on the broadest, flatest and easiest trails can you afford to look around and enjoy. Try it on any of my trails, and as likely as not, you're sprawled flat, cut and bruised. When I started running my easy trail last year, I fell almost every day for the first couple weeks, including three falls on one run.

You learn (1) concentration, (2) footing and (3) placement. The concentration is mandatory since a moment's carelessness can result in a fall which could mean broken bones or even a brief trip over the side which would end your running career–among other things.

Footing is, in part, learning what is safe to step on and what is not. On my trails, stepping on rocks is unavoidable. The general rule of thumb is to step on the smallest rocks possible. The largest rock you step on is the one most likely to give you trouble. The consistency of the trail determines the sizes of rocks safe to step on. If the underlying surface is hardpacked, even marble-sized rocks can cause trouble. If the underlying surface is soft (sandy or gravelly), fairly sizeable rocks can be run on with relative safety.

The second part of footing is to avoid clipping protruding rocks or roots.

Young is lucky enough to do his running on rocky trails. But Ian Stewart's (left) surfaces are more typical of those encountered by city-dwelling runners. (Tony Duffy photo)

This means picking up your feet. Road runners in particular have a marked tendency not to waste energy by kicking up their heels, bringing the foot through with only an inch or two of clearance. If a rock sticks out 2-3 inches, splat! A fairly simple technique which keeps the feet out of such trouble is to flail the feet out to the side (the way many runners untrained do naturally, especially women). This action lifts the feet, bringing them through quite high, and plants them more from the side. The side plant means that if you clip a rock, you lose sideways momentum rather than forward momentum. Loss of forward momentum means loss of balance, a fall.

Placement means the ability to accurately place your feet exactly where you want them. Road running allows errors of inches in foot placement without harm. On a trail, error an of one inch can mean a fall. This accuracy is learned, drilled into becoming a reflex action. The eye surveys 2-3 steps ahead. The mind chooses the best footfall, almost subconsciously. The rest is reflex, finely tuned by a million such foot placements.

The Hows and Whys of Falling: In the process of learning good trail running technique, you will fall. No maybe's, you *will* fall. Eventually, your concentration will lapse at the wrong time, you will become overconfident or perhaps just choose a poor footfall, and... Therefore, it is important to know how to fall and not be unduly afraid of falling. In a word, *relax*! Sure, you find yourself, airborne, heading toward a three-point landing in a pile of jagged rocks and I tell you to relax. Believe it! I should know. I've taken enough falls, all without hindering my running. I fell three times coming down Pike's Peak in 1973, losing perhaps 20 seconds total. But by pushing the pace, I figure I made up a couple of minutes at a cost of a sprained finger (jammed into rocks twice), minor gouges on my right elbow and palm, and slightly skinned knee. The idea, of course, is not to fall. But if you find yourself temporarily airborne, *relax.*

Falls are most frequent while running down hills. Such falls almost invariably occur by clipping a rock or root and are associated with a relaxation in one's concentration as one relaxes on the downhill stretch. Falls on the level are less common and are due to the same cause as downhill falls. Falls while running uphill are rare but may occur through a bad choice of footfall, where the rock slips out from under you as you put weight on it. The moral is to maintain your concentration while running downhill.

Footgear: What kind of footgear is best for trail running? Footgear should be relatively light-weight and flexible, yet protect the foot from penetrating rocks. Traction doesn't seem to be as important as a flexible sole. Originally, I used Tiger Marathons and wound up with rather bruised feet. I then made polyethylene inserts which were thin, flexible and protected my feet. This worked fine as far as running went but the relatively deep ridges in the sole rapidly became shredded and torn off, a result of the skidding downhill technique. In addition, the outside edge of the nylon upper quickly wore through, cut up by rocks. Four to five weeks on my trails would totally destroy a new pair of Tiger Marathons. I finally settled on Tiger Bostons without the protective inserts. The sole is thick enough to provide adequate protection from rocks and the extra thickness elevates the upper enough to avoid the wearing and splitting. The shallow ridging on the soles is resistant to shredding and these shoes seem as durable on trails as they are on roads.

FINDING ROOM TO ROAM

The greatest day-to-day threat to a runner's life and limb is the one he courts each time he steps onto the street. It's so familiar, he may not even see it as much of a threat. Yet the automobile may kill and maim more runners than heat, cold and heart attacks combined.

In this confrontation, the advantage is all with the automobile. It has speed and size on its side. The roads belong to it, not to runners. We are the intruders. Under the best of conditions, we are not safe on the streets and highways. But we often have to run there because there is no place else to go. If that's the case, then we must run defensively. Figure no one is going to watch out for us, so we have to take care of ourselves.

Marathon Handbook has published several defensive running rules:

- "Stay off the busiest streets.
- "Only use roads with a 'safety margin'—a sidewalk, or at least a wide shoulder.
- "Run on the left side of the highway—facing traffic—so you can see what's bearing down on you and have a chance to jump before it's too late.
- "Don't challenge the drivers when they have a weapon in their hands."

On the last point, the article quotes Hal Higdon, who says, "Under stress, any person's judgment can become impaired. When it comes down to those last few miles of a long distance workout, it becomes irritating to have to move over when approached by a speeding car. Yet consider the alternative if you don't move.

"I know many runners who take the position that it is they, not the drivers, who should possess the right-of-way. They run into traffic as though daring drivers to hit them, forcing cars to swerve across the center line to pass. I consider this an act of arrogance. More than that, I consider it an act of suicide."

It is equally suicidal to run along a busy, narrow street in the darkness of early morning or evening. A runner's weapons are his vision and his visibility. Car lights blind him in the dark so he can't see where he's taking his next—and perhaps last—step. Yet the same lights may not pick him out of the dark for the driver until it is too late to stop. Finding another time of day to run or another route shifts the odds back in the runner's favor.

The routes one runs are set largely by where he lives. Most of us run from home, and the surrounding territory determines the safety, surface, terrain and variety of courses. Explore the area and make the most of what you have. Lay out and measure routes which best combine the features you want in your running.

A topographic map can tell you more about your area than can a gas station map. The topo lists elevations, natural features and trails that are of no interest of motorists. You can also measure courses from the topo with good to excellent accuracy.

If you want an accurate measurement, forget about checking it with the auto. It almost always gives a short total. Instead, use the topo map (see in-

structions later in this chapter) and/or a calibrated bicycle counter.

The counter (one is available for about $10 from Alan Jones, 3717 Wildwood Dr., Endwell, N.Y., 13760) fits on the front axle of any bicycle. Then the bike is calibrated against a measured course. For AAU race course certification, the calibration course must be straight and at least a half-mile. Shorter courses (like quarter-mile tracks) are adequate for personal use. Once the bike counter is calibrated, simply ride the course and make the necessary calculations.

Ted Corbitt, who certifies courses for the AAU, says the bicycle method of measurement "has an accuracy of plus/minus 10 yards in 25 miles." A car odometer may be off by a hundred times that much. The car just never stops making life miserable for runners.

MAPS WITH THE ANSWERS

BY BOB BARD

Bard is a professor of geography at Oregon State University, and an active long distance runner.

Runners can use large-scale topographic maps in several ways. Typically, favorite routes are measured to find out how long they are, thus providing a check on pace and performance. Runners who time themselves can't find out their per-mile pace unless they have measured the route fairly accurately. Maps also are used to lay out courses for road races, and can be used to plan a training route which is similar in distance and terrain to the course of a coming race.

If you like to check your pace on daily runs, you could use a map to establish the various mile points. This would be even more useful in a road race, where there are few times given. Then, even if you had never run the courses before, you could at least avoid major errors in pacing.

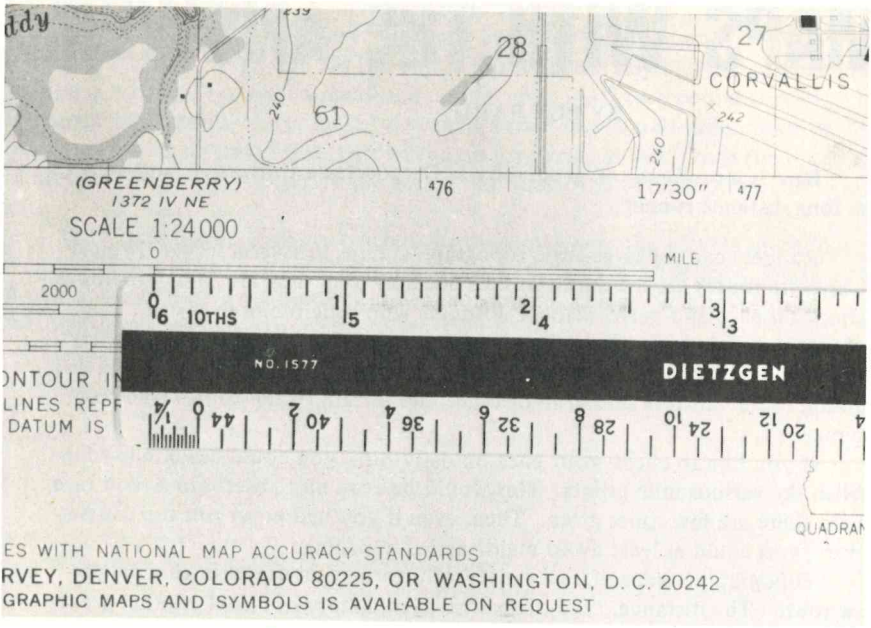
Topographic maps offer a variety of information useful in choosing a new route. The distance, type of road surface, nature of road (whether winding or straight), and the number and steepness of hills can all be determined from a map. Shadiness, type of scenery, and sometimes protection from wind can also be established.

For most purposes, the topographic maps produced by the US Geological Survey are best—and the larger the scale the better. Many of the more populated areas of the United States are covered by 1:24,000 scale maps. These show more detail and are preferable to the 1:62,500 scale maps if available. Either type of map may be sold in a local store. If not, write to the Geological Survey for a free state index map, which shows all topographic maps in your state.

The address for all states east of the Mississippi River is: Distribution Section, U.S. Geological Survey, Washington, D.C. 20242. If you live west of the Mississipi (or Minnesota or Louisiana), write to: Distribution Center, U.S. Geological Survey, Federal Center, Denver, Colo. 80225. On the state index map, find the name of the map covering the area you want, and send in 75 cents for each map you want.

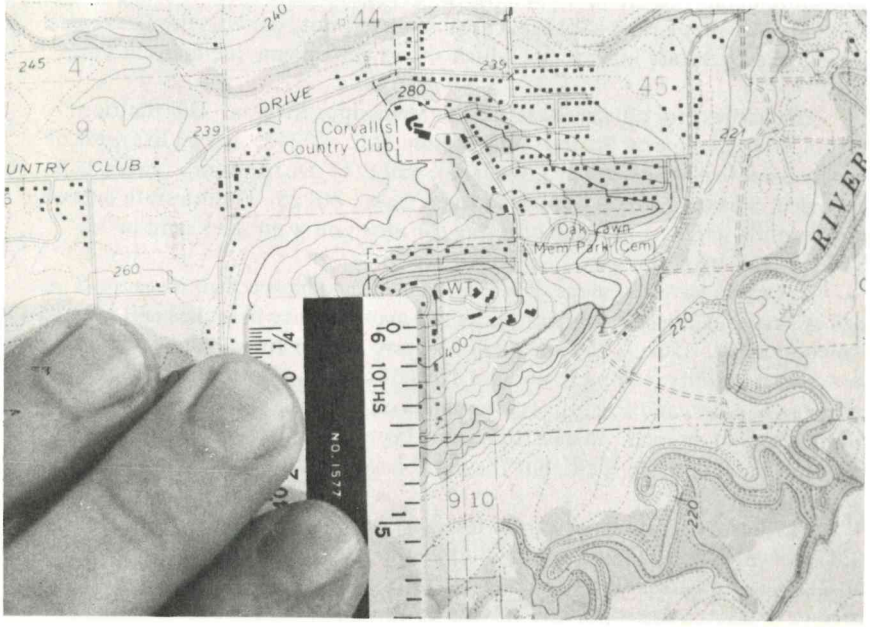
Once you have the maps, it would be useful to have a map measure. These devices have small wheels which roll off the map distance in inches and give results on a dial. Usually the cheaper ones have a short fixed handle and a single hand which permits reading to about a 10th of an inch. Better instruments have long handles, and sometimes two hands on the dial, allowing readings to about a 50th of an inch. In addition, some types swivel so you don't need to turn your hand in using them, but they still have the limited accuracy of the one-hand type.

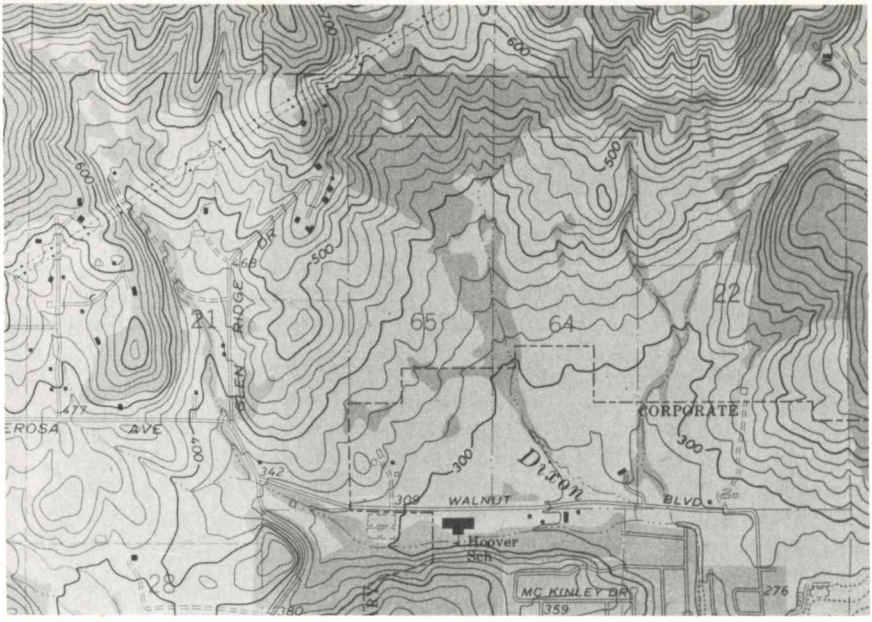
The best type of map measure for most purposes is the Keuffel & Esser 62 0315, which has a long fixed handle, two hands (reading 10ths of inches and feet), and a wheel with markings of 20ths of inches. Decimal fractions are much easier to use when multiplying by miles per inch, although most



ABOVE: The length of a mile, measured along the graphic scale of a map with a scale of 1:24,000.

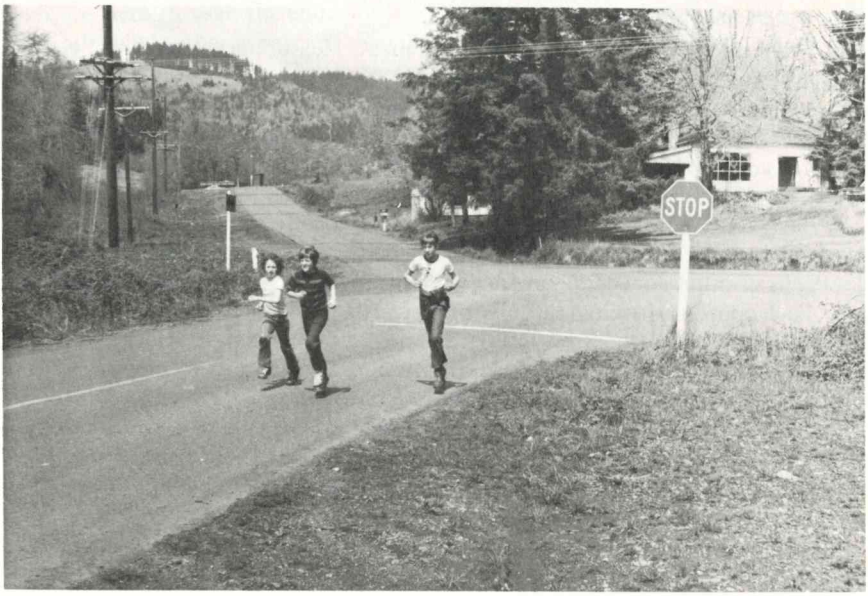
BELOW: Measuring the horizontal distance with a 10th-inch scale in order to calculate percent slope.





ABOVE: A hilly area on a 1:24,000 map. Darker areas are woods shown in green on the map. Contour interval is 20 feet.

BELOW: Young runners at the intersection marked on the map as elevation 342 feet. The house is a black square on the map.



two-hand measures read in eighths and 32nds. Cheaper measures will do the job, although the short handles are hard to use. Map measures are sold in stores which handle engineering, drafting and office supplies, and they can also be bought by mail order from outdoor equipment suppliers and others. Three examples are:

1. short handle, one hand, with compass. $2.50. Cat. No. 13 E 41015 from Lafayette Radio Electronics, 111 Jericho Turnpike, Syosset, L. I., N.Y. 11791.

2. long swivel handle, one hand. $9.60. Keuffel & Esser, Cat. No. 62 0300.

3. long fixed handle, two hands. $12.50. Keuffel & Esser, Cat. No. 62 0315.

To measure distance, roll the wheel of the measure until the hands point to zero. Then carefully roll off the distance along the road on the map, with the handle nearly vertical. Read the number of inches on the dial (and on the graduated wheel, if you have a two-hand type), and then multiply this times the number of miles per inch on the map. Topographic maps don't normally give the scale in miles per inch. The most accurate way of finding this is to divide the large number of the scale ratio on the map by 63,360 (the number of inches in a mile). Thus, on a 1:62,500 scale map, there is 0.986 mile per inch, and on a 1:24,000 map there is 0.378 mile per inch.

Distances in miles can also be found by running the measure backward to zero, along the graphic mile scale on the map. This might take several trips along the scale, and you'd want to wind up on the part that's divided into fractions of a mile.

If you had measured 13.2 inches on a scale of 1:62,500, this would be a distance of 13.2 x .986 = 13.02 miles. Of course, you can round off to 10ths if you like, but this wouldn't be very useful for pace calculations at shorter distances, such as four miles.

What about the effect of hills on distance? Measurements on a map can only give horizontal distances, and not actual road distances up and down hills. It turns out that this discrepancy is quite minor, unless there are many steep hills. Distances on a 5% slope (rising five feet in each 100) would be 0.13% farther than shown on a map, or only seven feet per mile. And on a relatively steep 10% slope, distances would be 0.53% greater, or 28 feet per mile.

Heights of hills and their steepness can easily be found on topographic maps. Elevations are numbered on the heavy contour lines, and to find the elevations of other contours, you count up or down from the nearest numbered one. Each contour is a fixed number of feet higher than the adjacent one on the same slope. This "contour interval" varies from one map to another, but is stated at the bottom of each map. Hilltops and the summits of ridges are recognized by being enclosed by continuous contours.

The quickest way to find how much climbing you have to do on a particular hill is to count the number of contour lines crossed since leaving the bottom, and multiplying this times the contour interval. You can also subtract the elevation at the bottom from that at the top.

Steepness is generally shown by closely spaced contours. But to find out exactly how steep a hill is, we compare the vertical rise to the horizontal (map)

distance. Percent slope is a common way of expressing this (% slope = vertical rise in feet divided by horizontal distance in feet times 100). Note that the horizontal distance must be measured in feet, not miles. (To convert the map scale into feet per inch, divide the large number of the scale ratio by 12).

The slope in the photo on page 76 (bottom) shows a vertical rise of five contour intervals (20 feet each), or 100 feet, in a map distance of 0.48 inch. On this map, of 1:24,000 scale, one inch equals 2000 feet. So 0.45 inch = 960 feet of horizontal distance. Then it follows that the percent of slope here is 10.4%. In cases where a more detailed knowledge of the terrain is needed, a profile along the route would be drawn.

Another way of using maps would be to find and mark the mile points along a running route. This involves finding out how many inches per mile there are, in order to place a mark when the map measure reaches the value for one mile, etc. To do this, divide 63,360 by the large number of the scale ratio. A 1:24,000 scale is calculated to have 2.64 inches per mile. As the map measure is rolled along the course to be marked, stop and place a mark when it reaches 2.64 inches, 5.28 inches and so on. Later, work out a system of relating these marks on the map to specific buildings, streams or other landmarks in order to find them when you're running that way.

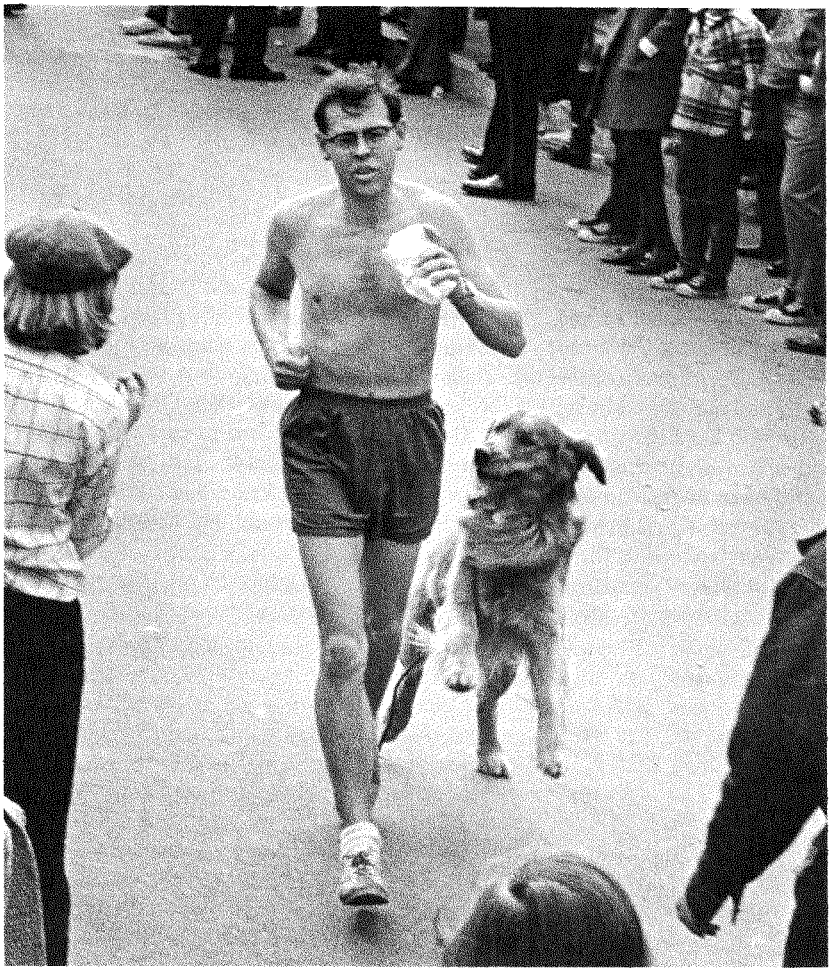
Once you're familiar with reading topographic maps, you will be able to lay out and measure running routes for different purposes: staying in shade on hot days (look for green), duplicating the course of a coming road run, choosing a winding scenic run, or taking road surface type into consideration.

One of the more useful aspects is to plot mile checkpoints for a road race, so you can time yourself, keep a steady pace, know where you stand and how far you have before the finish. Once, after I had come in two seconds ahead of a rival, it turned out that he didn't realize it was the last hill and he had still been saving something for the finish. I didn't know the course from having run it but tried to become familiar with the terrain, and thus knew when we were close to the end.

Although other aspects of map use by runners could be mentioned, certainly the most useful ones relate to distance and terrain information, as summarized here.

Chapter VI

PEOPLE AND PETS



You'd think that a runner in the Boston marathon could escape the dog menace. Not so. This dog has broken free from its master and is going for the finish line—or is it the man's leg he's after? (Rick Levy photo)

THE OFFENSIVE ELEMENTS

BY JOHN SAMORE

Samore, a sub-4:10 miler, was a graduate student at the University of Iowa when he wrote this article.

The topic of this booklet is not as narrow as many would have us believe. Elements are meterological phenomena. As a native Iowan who has had his eyes frozen shut and almost lost an ear and a finger to severe frostbite while running, I am certainly cognizant of this facet. But the term is more inclusive than this.

"Elements," by my definition, include any externalities that tend to inhibit the runner in his solitary pursuit. Since others have quite thoroughly dealt with protection in and limitations of severe climatic conditions, let us discuss several other restrictive elements: dogs, cars and people.

One basic truth which operates to the runner's benefit: is that the domestic canine is inherently a coward. Once he realizes you fear him not, his interest quickly wanes. Therefore, take Dr. Doolittle's advice and "talk to the animals." You must speak in terms the mongrel understands. In other words, growl, scowl, snarl, sneer. In my decade of running, only once has a vicious gutteral utterance failed to stop the advancing beast.

The other form of expression a dog readily comprehends is borrowed from the soccer field. Give your four-legged nemesis "something to remember you by." No harm is intended, but a well-aimed kick to the throat or snout (after sufficient practice, you need not even break stride) will cause the pooch to do his barking from a distance in the future.

The varied responses of owners to such measures is, indeed, ironic. Although they snicker approvingly when their pet takes after the "crazy jogger," they are stunned or even infuriated when their dog—by law required to be leashed—suffers so humiliating a setback. But on rare occasions, an owner equally annoyed by his pet's lack of restraint may thank you for the lesson you have given.

Athletes and automobiles also appear doomed to eternal conflict, as noted in chapter five. The greater risk is undeniably the pedestrian's, though the courageous (and perhaps foolhardy) runner can leave his assailant with memory of their confrontation by a well-placed blow to the body (of the car... we're not *that* aggressive!).

Each time a runner is baffled by the driver's aversion to sharing an open road, if not his outright attempt to maim, he must consider the source. No matter what they may say about our "eccentricity," the runner remains a constant reminder to the driver of his own personal shortcoming—approaching and encroaching age, hastened by his failure to preserve his fitness by some form of physical activity. This love-hate emotional conflict within the driver's mind is made acute each time he sees the runner out for his daily jaunt while he is taking his crutch four blocks to the store for more beer.

The final element is the insulting pedestrian. I refer not the the innocence of a young child's "Here come the joggers," which cuts the competing

runner to the quick. The real focal point is the smart-aleck on the streets of every town throughout the world and his unoriginal "Hup-two-three-four" or "Are you a runner?" Silence is often appropriate, but the Higdon-esque retort to the latter query, "No, I'm training to be a purse-snatcher!" has so cutting a ring as to be worthy of any runner's repertoire.

The point of the elemental dilemma is, as with inclement weather, we runners needn't fear the other elements if prepared. A few well-chosen phrases (said with a smile and not a gesture), a feignable innocence and a dash of daring are as essential to survival with these elements as are a net vest or long underwear to handle the cold.

REPELLING DOG ATTACKS

"When I finished my seven-mile run and realized that I had missed my personal record by 25 seconds, I called the police. Attacks by dogs and dog owners are not all that serious. But 25 seconds..."

The time it took runner Charles Phillips to stop and hold off a charging dog and a subsequent attack by its owner, "who hit me with a carpenter's rule while comparing my ancestry with his dog's," cost Phillips at least a minute. And a minute to a runner is an eternity.

No runner has time to stop when the watch is on him. And that's the worst thing about the dog menace—which is more of a nuisance than a danger. The runner has to stop. If it were simply a human heckler yapping at him, he could ignore it and run on by. The heckler's attention span is incredibly short. He quickly loses interest. But the dog is more persistent. Ignoring him and running away provokes more vicious action.

The dog can't help himself. He's following his instinct. When a stranger invades his territory, the dog is compelled to growl and bark and otherwise carry on. When the stranger runs away, instinct tells the dog to give chase. He can't help himself. But knowing this bit of dog psychology doesn't help the runner under attack.

When a dog charges him, a runner has one of two courses of action to take. He can take the blunt, violent approach. Hurl a rock. Kick the mutt in the chops. Swing a baseball bat. Squirt him in the nose with ammonia. This may be the most satisfying kind of revenge. But it is a risky solution which may get retaliation from the dog's owner.

A safer method is to employ understanding and persuasion—not necessarily friendly persuasion, but at least more subtle than a blow to the skull. The first step in dealing with dogs is knowing how they react when threatened. Animal psychologist Konrad Lorenz says in his book *Man Meets Dog* to look at the dog's tail, ears, mouth and hair for clues:

"The dog's tail acts as a barometer of self-confidence. If the tail is erect, it means that the dog feels confident and unafraid. But if he lets his tail fall, he is admitting he will no longer stand his ground if threatened.

"Ears also give away the dog's confidence. Straight up means 'alert, confident.' He's ready to fight, if necessary. Laid back close to the head, the ears signal deference or friendliness. The dog means no harm and wants only to be petted.

"The third measure of a dog's aggressiveness is his mouth. A 'smiling' expression with lips drawn far back indicates, "I'd rather not fight.' Lips puckered forward, though, are a sure sign that the dog has serious intentions of attacking. Don't provoke him.

"Add to this the well known raised hair on the back of the dog's neck and you have four indications of trouble ahead."

Tom Osler thinks he has a sure-fire (almost) method of dealing with dog attacks. In nearly 20 years of running, the method has failed him only once. Osler first lists facts about dogs which every runner should know:

- "You can't outrun a dog.

• "Many dogs, who are otherwise calm, are alarmed by the sight of a man running.

• "The closer you are to the dog's house, the more aggressive he becomes.

• "Dogs seem to enjoy chasing (and sometimes biting) persons who they sense fear from.

• "Dogs are natural cowards. They simply will not engage a runner who does not appear to fear them, and who gestures in a manner which is aggressive to them.

• "Dogs are more readily held at bay by fear than by pain. (If I were attacked by a dog pack, I imagine it would be better to have a garbage can lid than a knife. Beating on the lid with a stick should create sound which frightens off almost any animal.)

• "Stopping usually placates the dog.

• "When a dog bites a man, it is almost always by attacking him from the rear."

Osler tells runners to stop and turn on the dog as it approaches, shouting and gesturing at it. This first line of defense works in most cases.

If the dog keeps menacing you, making it impossible to run, reach for a stick, stone or other object. Osler says, "The simple act of reaching for an instrument usually causes the dog to lose heart."

Only if the dog keeps coming at you, ready to bite, are more violent measures called for.

Ted Corbitt adds this advice: *don't take your eyes off the dog*, even if it is a friendly one. Corbitt says, "A runner is potentially in as much danger from being tripped by a dog as by being bitten. Even a little puppy can drop you in your tracks if it bumps into your leg while you are in the floating (both feet off the ground) phase of the stride. The danger of broken bones is real. Thus, it is important to keep track of a dog until you're definitely out of its range."

Dogs are the immediate problem. But the dog menace is really the responsibility of the owner of the pet. If you want lasting action, go to him.

Pete Strudwick writes, "I keep a file. It has a record of all dog attacks, their dates, the circumstances and the owner's probable address. When I can no longer get by some Fido's haunt without turning the encounter into a military operation, or when some pooch actually breaks my flesh, I call city officials—the police, the dog pound and, if necessary, the mayor himself.

"I'm pleased to say I've had more than one irresponsible owner compelled to leash his irresponsible dog. And I'm not the only one to benefit. If I'm going to fight, let it be on productive terms."

Speaking of productive, Desmond O'Neill offers this advice: "Find a prosperous-looking mutt with tags. The owner probably is covered with homeowner's insurance policies, which if suitably massaged will pay off handsomely for the innocent running victim. Then get yourself bitten—not badly, but in Technicolor. I know. I got gummed by a short-haired pointer once in a well-to-do end of San Francisco. I went to Europe for six months on the settlement."

IT STARTS AS PUPPY LOVE

BY DR. JAY LUCAS

Dr. Lucas, a clinical psychologist, practices in Rochester, Minn.

With the incessant urging of my fellow runners (i.e., one of them casually mentioned it once), I have taken pen in hand so as to bring the most powerful weapon of mankind to bear on the most important social conflict of all time. As a clinical psychologist, I immediately sensed my purpose in life, my reason for being and my gateway to immortality while being pursued by my first canine some four years ago. After much tedious and frequently hazardous data gathering, painful introspection and rational-deductive logic, I finally have the answers.

We psychologists, you see, are experts on the relationship between childhood experiences and adult feelings and behaviors. As you know, animal studies are often conducted to give us understanding of human functioning. However, I have moved beyond this one-way limited inferential system to the freedom of "regressive inference." That is, I have taken the cornerstones of human personality and hurled them into the animal kingdom. (This should not be confused with my less scientific experiments of cussing and throwing stones.)

At one time, all dogs were lovable, cuddly, cute puppies. As such, they waddled around and evoked much cuddling, hugging, stroking and generally good feelings. Like people, dogs grow older. They also become more awesome physically, such that they become more impressed with themselves and less impressed by others. Occasionally, a dog will take it upon himself to demonstrate to others what a magnificent beast he really is. The manifestation of this urge often results in the chesty chewer avidly pursuing and "doing his thing" to an innocent runner.

The cure is simple, direct, and although it does lack the feedback rewards of a swift kick to the ribs or the "chunk" of a dirt clod exploding on the skull of the offender, an insuperable intellectual reward is afforded. Only those who have plumbed the depths and ascended to the heavens with pure knowledge can appreciate at a gut level what I am saying.

Here's the procedure: When the dog is well within earshot, you must restrain all unkind, harsh, assertive behaviors and in a very paternal (or maternal) manner mention, "how cute the puppy is," "how nice the puppy is," and how "silly puppy should go home now." The keys here are kindness, warmth, and most importantly repetition and emphasis of the key word "puppy." This word puppy contains magic for it is the key to unlock, even in the most hostile beast, the well of warm feelings experienced as a puppy. The unfailing response of the dog converted for an instant into a puppy is a wobbly bottomed, foolish and embarrassed doggie sheepishly retreating from a very smug, intellectual, rational runner with true *savoir-faire.*

This never-fail method has since failed me two times, which has led me hurriedly back to the couch for further reflections and theory refinement. I slowly began piecing together a rational explanation with the recollection

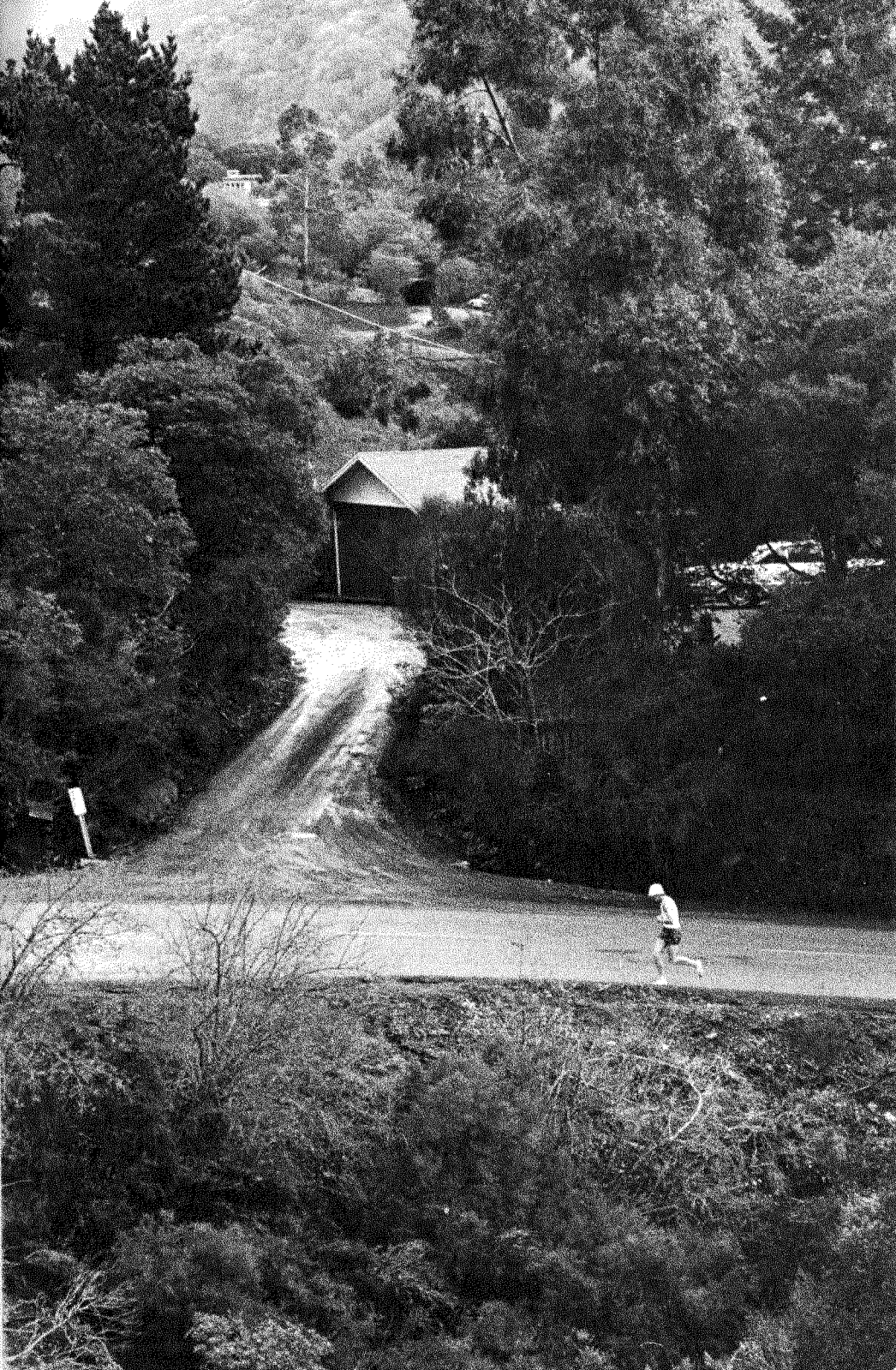
that the day of failure was the day of Christmas and the day before the second failure. I then became aware of the local paper's critical involvement in this affair when one of my patients informed me of an important story that had appeared in the paper about dogs and me. Blinded by a shocking flash of insight, I fled for the phone to finish the formulations regarding the fiendish, four-footed felons. I simply and directly accused our local sportswriter of inciting the local dog populace by his Christmas article wherein he had wished "Jay Lucas of the Rochester Track Club, especially when he's running, fewer dogs." I was certain that at least two dogs had read the article, been offended, and therefore attacked me!

However, the writer's confused and embarrassed chuckle ripped my entire theoretical formulations and my total being to shreds. I was left a whipped, beaten and limp jogger. Into these moments of deep despair came floating that inspiration muttered to me by a teammate in the middle of a 24-hour relay: "When the tough get going, the going gets tough!" (Sometime later when oxygen, rest and nutrition had restored more normal intellectual functionings, I was to reverse his original declaration.) I dug in and with an unsurpassed second effort reapplied my basic tenets.

It was simple after that. The dog that attacked me the day after Christmas of course had not been offended by the newspaper article. He was plain and simply a "Heinz 57 variety" mongrel who probably had no idea of his parentage. As a result, he had an unloving, uncared for puppyhood with no personal identity other than not knowing who his father was. Of course, this dog had a dynamic bone to pick! He was entitled to vent his hostilities to me because that's what psychologists are for. The important lesson here is to regard each dog as an individual who has a right to be here. In and of itself, the dog is doing its best with its own being, limitations and strengths. Each dog is okay.

What about the Christmas day attacker? Well, that's a dog of a different color. He was one of those boxers. What comes out naturally is the boxer's personality. Within the boxer resides the heart and soul of the very devil. This pampered, man-created, overbred animal can only be dealt with symptomatically by frantic phone calls to the dog catcher. The true cure is a maple stake plunged deeply into his chest cavity.

The runner's dream: A quiet country road, clean air, no cars, and above all no people or dogs to disturb the serenity of the run. (George Beinhorn photo)



"OFFICER, I WAS ONLY..."

BY DWIGHT DALBEY

Attorney Dalbey lives in the Washington, D.C., area.

One of the occupational hazards of the runner is a chance encounter with "the law." It need not be disastrous or embarrassing. A simple code of conduct will at least minimize the chances of the encounter and usually will leave no residue other than a smile. I am a lawyer, a runner and one who runs in strange cities. I have had favorable contacts with policemen, simply by following a few simple rules which I recommend to all runners.

• First, make a conscious attempt to obey the law. This is by no means to suggest that members of our fraternity intentionally do otherwise but rather that there are so many laws and ordinances that most of us become careless about the little ones. We exceed the speed limit just a bit, litter the street with chewing gum wrappers and, as runners, sometimes jaywalk. By our carelessness, with the law, we invite the official attention of the policeman.

To observe the laws and the ordinances adequately, for the limited purposes of our sport, it is not necessary that one know them to the letter. For example, when running in a strange city I assume the existence of an ordinance against jaywalking. I so assumed in Miami Beach one summer while running up and down Collins Ave., the main thoroughfare. Changing sides of the street added variety to an hour-long run, but always I crossed with the green light. The police cars went right on by. In Seattle, I ran up and down the hills in the center of the city, anchoring on the police station on the downhill end and stopping when the crosslight was against me. Like any veteran runner, I break my pace reluctantly. But it is surprising how many green lights one can catch, and the policeman only smiles at your eccentricity.

• A second rule is, run at a time and place of maximum freedom for onself and minimum inconvenience to others. Running at home I am on the suburban streets, winter and summer, with the newsboys and the milkmen shortly after 5 a.m. This has a bearing on the police attention which I am likely to draw. In the enforcement of minor rules like those against jaywalking, the policeman is inclined to balance the equities. If your violation is purely technical, committed in circumstances neither endangering nor exasperating anyone, he can look the other way. In fact, he must. Were the policy otherwise, the jails would be filled to bursting with jaywalkers alone.

Time and traffic are important to the equities. Constitution Ave. in Washington, D.C., is six lanes of traffic, and at 7:30 a.m. the morning rush has begun. The famed avenue is surely one of the most dangerous streets in the nation's capital on which to jaywalk, and especially so at rush hour. At that time the jaywalking balance of equities shifts radically in favor of the motorists, who also has a shake in the matter. If the ordinace is to be enforced at all, it is precisely here and at this hour that it should be enforced most zealously.

• Third, dress conservatively when running in strange cities. There may

be a broadly interpreted ordinance against indecent exposure (in this libertine age?), or a certain sensitivity among some of the natives to the sight of a hairy chest. In summer at home, I run in shoes, socks and trunks. In other cities I don a thin, almost transparent "wash and dry" shirt with long sleeves. The runner so attired is by no reasonable stretch of language indecently exposed. He is more presentable as he goes out and comes in through the lobby of the hotel and less likely to offend. Whether one's fellow citizens should or should not be offended is immaterial. It is easy to dress in a way that will not offend.

• Fourth, wear your insignia. Some who see you jogging will consider you a "nut." But if you wear an insignia showing that you below to an organization of "nuts," you have the moral force of organization behind you. You are now more of a force to be reckoned with, and the point will not be missed by either policeman or passerby. I am a member of the National Jogging Association and I wear the distinctive patch on my togs.

• Fifth, wear some identification, just in case of emergency. Show your name, address, and home telephone number. A piece of hotel stationary in the shirt pocket will become wet with sweat, but it still will link you to a local address.

• Sixth, try on the shoes of the policeman. He sees the other side of the coin which you may have overlooked. At about 5:15 one bleak and black winter morning many years ago when running was unknown in my home area in the Maryland suburbs of Washington, D.C., I was stopped by the Montgomery County police, who patrol my area. From the route and manner of their approach, it appeared they were looking for me. They asked me where I lived and what I was doing. I told them. The officers smiled indulgently and drove on.

I do not know the origin of their official interest, but I can imagine a likely possibility. Some bleary-eyed householder, probably a woman, caught a glimpse of a shadowy figure running past in the darkness. She panicked: "The West Side rapist strikes again!" She called the police and they responded. They did what I would have wanted them to do had the caller been my own wife.

This is the other side of the coin, and the policeman sees it. We should understand, for we are householders with families to protect, motorists who sometimes are exasperated—or even endangered—by jaywalkers, and so on.

THE UNIVERSAL HECKLER

The heckler is universal. Runners find him in every city of every country. The words he hurls are about the same wherever you go. Only the language changes. "Hut, two, three, four" and "faster, faster" by any other name sound just as obnoxious.

The repertoire of the heckler is only a little less limited than that of the yapping dog. The cadence count, the sarcastic urging to speed up, the "Where did you leave your clothes?" and the "What are you running for?" are about the extent of it. If hecklers would be more original in their choice of taunts, they'd at least give us some entertainment. As it is, they wear away at our patience like a Chinese water torture.

It's easy to say, "Just ignore them. Words can't hurt you." But a runner has only so much tolerance, and it grows thin with time. Frank Shorter once told a *New York Times* interviewer, "Jack Bacheler is one of the mildest men I know. But I've seen him go berserk when people bother him. Me, too.

"Once a couple of guys stopped at a red light after bugging us, and we ran right over their car, over the top and across the hood, and kept going. Sometimes it's been worse than that. Maybe it's the adrenalin we generate. We don't bother them. Why should they bother us?"

They do torment us for reasons we can't comprehend—hate, jealousy, fear?—and runners like to be armed with suitable responses. Bacheler's and Shorter's gesture was a classic. It involved no vulgarity, no threats, not even any words. They simply struck a symbolic blow for man-over-automobile and hit the hecklers where they lived.

The secret of dealing with hecklers is to meet their crudities with humorous and original responses. It isn't easy. You usually don't think of a good one until you're a block down the street, out of earshot. Timing is of the essence.

Hal Higdon catalogs snappy comebacks in the opening chapter of his book *On The Run From Dogs and People.* They all fall in the now-why-can't-I-think-of-that category. You're welcome to use them yourself, since it's safe to say that no heckler will read the book.

During a run with Ted Corbitt, Carl Zayas was asked, "What are you running for?" Zayas was ready with an answer which Higdon says should be tattooed on the forearm of every runner: "We're winding our watches."

When any man asks Michael Beck what happened to his pants, Beck's response is, "I left them with your wife."

Dick Baron tells the story of being passed by a woman in an oversized convertible. The car had a phone. The woman slowed, held the phone out to him and said, "It's for you." Without missing a step, Baron coolly replied, "Tell them I'm not home."

But even among the quick-witted, verbal sparring gets tiresome. It does nothing for a runner's visions of high purpose and purity of body and soul to be the target of ridicule. So what if the hecklers are unthinking, frustrated slobs? You aren't going to rid the world of them by answering in kind. The wiser course is to follow one that avoids them. Let them get their kicks by picking on each other.

REFERENCES

Sources are listed in the order that they appear in the booklet.

CHAPTER ONE

Higdon, Hal–"On The Run," *Runner's World,* May 1970, p. 38.

Higdon, Hal–*On The Run From Dogs And People*, Henry Regnery Co., Chicago, 1971.

Bowen, Hugh, and Henderson, Joe–"Catching Up To California," *Runner's World*, May 1974.

Henderson, Joe–"Interview: Arthur Lydiard," *Runner's World,* July 1970, pp. 8-13.

Henderson, Joe–"Short Stops At The Peak," *Runner's World*, Sept. 1973, pp. 13-14.

"Plan For All Seasons," *Racing Techniques* (Runner's Monthly Booklet), July 1972, pp. 28-29.

CHAPTER TWO

Sheehan, George–"Cooperating With Nature," *Runner's World*, July 1973, p. 20.

Westerman, Richard–"Heat: Identifying Danger Signals," *The Trainer*, April 1, 1972, p. 1.

Henderson, Joe–"Coping With Heated Battles," *Runner's World*, July 1971, pp. 38-39.

"Wet Bulb Temperatures," *Encyclopedia of Athletic Medicine* (Runner's Monthly Booklet), June 1972, pp. 80-81.

Mirkin, Gabe–"Hot Weather Hints," *1972 Marathon Handbook* (Runner's Monthly Booklet), Jan. 1972, pp. 36-37.

O'Donnell, Thomas, and Clower, George–"The Circulatory Abnormalities Of Heat Stroke," *New England Journal of Medicine,* Oct.12, 1972, pp. 734-737.

Claremont, Alan–"Keeping Your Cool Running," *Runner's World*, May 19 1974.

Wyndham, C. H., and Strydom, N. B.–"The Danger Of An Inadequate Water Intake During Marathon Running," *South African Medical Journal*, July 19, 1969, pp. 893-896.

"Let's Drink To That," *The Runner's Diet* (Runner's Monthly Booklet), Aug. 1972, pp. 50-52.

Eisman, Martin–"Acute Volume And Electrolyte Changes–Consequences Of Dehydration," report to annual meeting of American College of Sports Medicine, 1973.

Sheehan, George–"Hot Weather Running," *Encylopedia of Athletic Medicine* (Runner's Monthly Booklet), June 1972, pp. 79-80.

Daws, Ron–"When It's Hot, You're Not," *Runner's World*, July 1973, pp. 18-20.

CHAPTER THREE

Lanin, Pat–"Living With Winter Weather," *Guide to Distance Running*, World Publications, Mountain View, Calif., 1971.

Claremont, Alan—"Keeping Your Running Cool," *Runner's World*, May 1974.

Van Aaken, Ernst—"Winterized Running Training," *Runner's World*, Jan. 1974, pp. 32-33.

Sheehan, George—"Treatment Of Frostbite," *Encyclopedia Of Athletic Medicine* (Runner's Monthly Booklet), June 1972, pp. 84-85.

Taylor, J. Karr—"Compensating For Cold," *Encyclopedia of Athletic Medicine* (Runner's Monthly Booklet), June 1972, pp. 82-83.

Sexton, Jim—"Dressing To Face The Cold," *Runner's World*, Jan. 1974, pp. 30-31.

CHAPTER FOUR

Consolazio, C. F., Johnson, R. E., and Pecora, L. J.—*Physiological Measurements of Metabolic Functions In Man*, McGraw-Hill Book Co., New York, 1963.

Phillips, Everett J.—"Wind: How Much Does It Help?" *Track & Field News*, II July 1973, p. 28.

Livingston, C. L.—"Applying Running Power," *Runner's World*, March 1973, pp. 24-25.

"Lightning Safety Rules," US Department of Commerce publication, NOAA/PC 70005, 1970.

Sheehan, George—"Altitude Adaptation," *Encyclopedia of Athletic Medicine* (Runner's Monthly Booklet), June 1972, p. 88.

Arnold, M.H.M.—"Benefits of Altitude Training," *Runner's World*, Nov. 1972, pp. 34-35.

Frederick, E.C.—"The Physiological Basis of Altitude Training," *Running*, Jan. 1974.

Hammerstein, Brice—"Statistics On Smog," *Runner's World*, March 1971, p. 39.

Nicolai, Bill—"The Dirty Air We Breathe," *Runner's World*, June 1974.

"Physician's Guide To Air Pollution Episodes," *JAMA*, July 10, 1972, pp. 190-191.

Sheehan, George—"Medical Advice," *Runner's World*, Feb. 1974, p. 36.

Sheehan, George—"The Air You Breathe," *Encyclopedia of Athletic Medicine* (Runner's Monthly Booklet), June 1972, p. 87.

CHAPTER FIVE

"Gearing Yourself For Hills," *Runner's World*, Oct. 1973, pp. 20-21.

Henderson, Joe—"Car Collisions," *1973 Marathon Handbook* (Runner's Monthly Booklet), Jan. 1973, pp. 15-16.

Henderson, Joe—"A Measure Of Success," *Runner's World*, Jan. 1971, pp. 54-55.

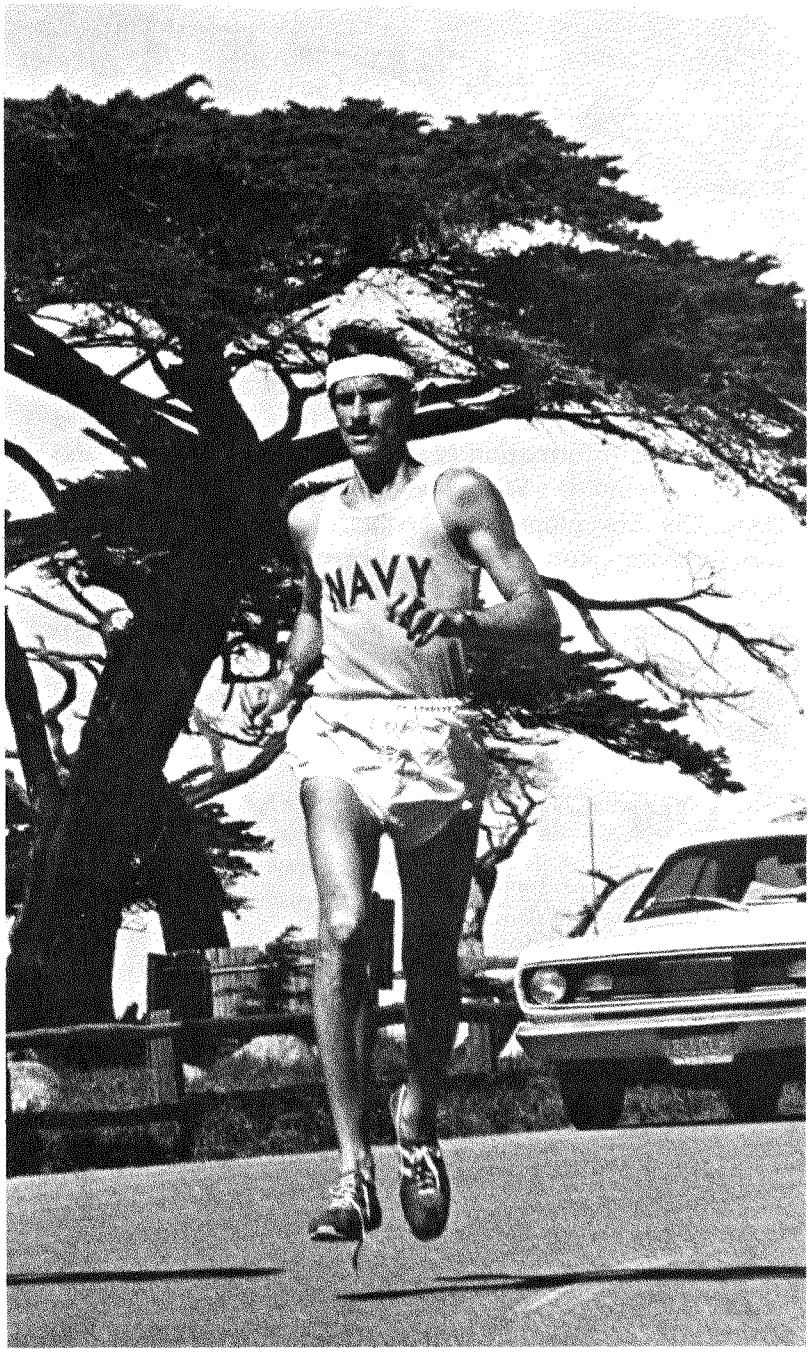
CHAPTER SIX

"Running Shorts," *Runner's World*, July 1973, p. 42.

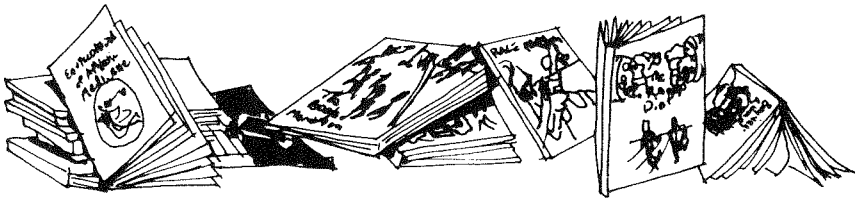
Osler, Tom—"Beating Man's Best Friend," *Runner's World*, July 1971, p. 31.

O'Neill, Desmond—"Readers' Comments," *Runner's World*, Aug. 1973, p. 47.

Higdon, Hall—*On The Run From Dogs And People*, Henry Regnery Co., Chicago, 1971.



2:20 marathoner Phil Camp races along the California coast. (John Marconi photo)



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31. 1974 Marathon Handbook	108pp.	$1.95
32. Runner's World Pictorial	52pp.	$2.00
33. 1974 Runner's Almanac	100pp.	$1.95
34. The Female Runner	36pp.	$1.25
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FRONT COVER:
A winter race in Vermont
(Robert George photo)

PHOTO LEFT:
Claire Morgan in a muddy Canadian cross-country championship.
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