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"Swimming"

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COACH OF AMERICAN OLYMPIC SWIMMING TEAMS,

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Preface

WHY ANOTHER book on swimming?

It certainly seems that the field has been well covered in all of its phases; beginners' swimming, intermediate swimming, advanced swimming, competitive swimming, water games, water safety, lifesaving and all the other phases of aquatic activity. Having this in mind, the writer has been reluctant to attempt any addition to the work already done. However, publishers who are forever sirens waylaying the unsuspecting, helped give the writer the idea that, as a result of his experience in competitive swimming over the years, especially with large groups in college and with Olympic and international teams, there might possibly be a word or two that he could contribute to the knowledge of competitive swimming. It is the writer's hope that the young coach, teacher or competitive swimmer may here find an idea or two that may be of some help.

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Contents

CHAPTER I

History

THE HISTORY of speed swimming is most interesting and, though the story has been told many times and in many places, it is altogether fitting for a book on competitive swimming to let the historians tell the story.

FIRST, THE STORY as told by Frank Beaurepaire, the great Australian swimmer who is now a very successful businessman in Melbourne. Mr. Beaurepaire's career in athletics is a shining example of the healthful qualities of swimming as a competitive sport. He was a top-flight swimmer in 1908 and was a finalist in the swimming races at the 1908 Olympic Games in London. Down through the years he was a prominent figure in international swimming and completed his Olympic career at the Paris Games in 1924, though he continued to swim nationally at even later dates. This represents a competitive career as a world-renowned swimmer from about 1906 to 1930. All during that time he was a close student of the sport and since the close of his competitive career he has devoted a great deal of time and energy as an amateur to further the cause of swimming in all its phases. This story was written following his trip to the United States as an observer and official at the 1932 Olympic Games in Los Angeles.

THE CHANGES IN SWIMMING STROKES

"When Captain Matthew Webb, the celebrated long-distance English swimmer, swam the English Channel from Dover to Calais in 21 hours and 45 minutes, on August 24-25, 1875, and created a furore throughout the world, he used the breaststroke method of propulsion. On August 6, 1926, Miss Gertrude Ederle crossed the Channel in 14 hours, 31 minutes, over seven hours faster than Matthew Webb. The young American girl, world champion of her time, used the crawl stroke practically throughout the entire journey. This span of fifty years may be considered an epoch-making one in regard to swimming strokes, and covers the history of changes made in the strokes used in competitive swimming. Both great efforts would also suggest a great contrast in methods and the relative differences in the speeds of the two methods.

"It must not be thought that other strokes were not used. In order of succession, the strokes mainly used in that period were the breaststroke, side-overarm stroke, trudgen stroke, australian crawl, trudgen crawl and the six-beat crawl, or as it is sometimes called, the american crawl.

"Although myself but little over forty, I can remember that it was with difficulty that the average swimmer got away from the breaststroke or the underarm side stroke. The majority of racing swimmers, and few of them there were, used either the breaststroke or an overarm side stroke, in which the body was turned on one side and one arm recovered above the water and shot forward slightly ahead of the shoulder to enter the water and pull back without submerging that shoulder. The underarm was thrust forward from beneath the chest until extended beyond the shoulder to make a pull-back beneath the body. At no stage did this underarm effect a recovery above water. In most instances a so-called frog, really a breaststroke, kick was made with the legs. Later this stroke was definitely improved by making the scissors kick a standard for leg movements. With slight variations this kick later became the basis of the leg actions in the trudgen stroke. In European countries the trudgen stroke was the first stroke with which both the arms recovered alternately above water. The stroke was originally introduced into England by a competitive swimmer by the name of J. Trudgen, who stated that he had acquired a knowledge of the stroke in South America. I understand that Trudgen first introduced the stroke to racing swimmers in the Woolwich Baths near London. At least this is claimed by old-timers connected with swimming at Woolwich. There is no doubt that double-overarm swimming (as it might have been termed then and before Trudgen's time) was known, but due to faulty technique and conception of the correct use of arms, if not of legs, the stroke was never taken up by competitive swimmers before the advent of Trudgen, as they did not think the stroke could be made fast. However, J. Trudgen's speed was so great for the period in which he raced that swimmers who had any pretense to championship form used the double-overarm method. However, due to Trudgen having been a breaststroke swimmer, and to the fact that he still retained the breaststroke leg kick in connection with his double-overarm action, swimmers for many years retained what we would now know as a faulty technique for this style of stroke.

"The development of the stroke from this faulty action to a scissors-kick action was brought about simultaneously by Lancashire and Australian swimmers. This would be back in the nineties. However, there was this nicety of difference in the two strokes. The Australian timing or rhythm called for the major scissors kick at the moment of thrust of the right or

left arm, that is, just as the hand was about to cut into the water. In the Lancashire timing the major kick was made when the arm was practically at right angles to the shoulder beneath the water. One should explain that in the trudgen stroke the one major scissors kick is made to two arm strokes. Therefore, the kick is made on one or other arm strokes, that is, right or left.

"Perhaps the greatest exponents of the Lancashire type of trudgen stroke were Harry Taylor, Olympic World's Champion 1906-8, Dave Billingham, great opponent of the late Barney Kieran, Australian champion of 1905, and T. S. Battersby of England.

"Taylor was a stocky man who got a tremendous drive from his trudgen kick. He had no pretense to sprinting ability at all and probably could not break sixty-three seconds for 100 yards, but he was tireless in distance swimming.

"The trudgen stroke is said to be an adaptation of a stroke that J. Trudgen saw swum by South American natives. That he wrongly copied the stroke is undoubted. It is also probable that from time immemorial the overarm and double-overarm strokes have been used chiefly by the inhabitants of countries bordering warm and tropical seas and in many cases, particularly in the Pacific, the stroke was a species of what is now called the crawl stroke.

"Organized racing and competitive swimming commenced in any sort of big scale first in England in the latter half of the last century, and with the spreading of competitive swimming over Europe and later further overseas, the copying of English methods was reasonable and logical, therefore. Although these were the basic elements of faster strokes in use in native countries, chiefly due to the fact that there was no international swimming organization and no visits from one set of swimmers to another beyond the confines of Europe, it was many years before these double-overarm methods of swimming were tried out. It was almost 1900 before any method closely allied to the modern crawl stroke began to be experimented with and exploited.

"The reason of the great improvement in swimming times over the last ten or fifteen years is found in the exhaustive study that has been made by swimming coaches of the crawl stroke."

WHENCE CAME THIS CRAWL STROKE?

"Evidence available points conclusively to the Pacific Islands. Duke Kahanamoku, in 1912, assured questioners that the stroke was natural to

the Hawaiians. Alex Wickham, a Solomon Islander who lives in Sydney, and who held the world's fifty-yards record for a fairly long period, has said that all children in these islands swim a species of crawl stroke. Wickham claimed that even before 1900 one of his brothers, who was being educated in Sydney, swam the crawl there on numerous occasions. Possibly because he was not a speedy or polished demonstrator, no particular notice was taken of him.

"Paradoxical as it may seem, Wickham swam a perfect six-beat crawl stroke. But mainly because he was 'finished' by seventy-five yards as a rule, his stroke was not copied in its entirety. However, a two-beat, heavy, muscular, leg-beat crawl was evolved which became known as the Australian crawl.

"About 1900 the then popular Australian champion, Dick Cavill, evolved, probably from what he had known of the native stroke, a style of swimming which was the origin of the crawl as a racing stroke, and which led to its later development all over the civilized world. In those days the stroke was known as 'Cavill's Splash Stroke,' and Dick was fond of demonstrating its effectiveness by giving starts to good swimmers, and swimming with his legs tied above the knees. This action of tying did little, of course, to interfere with the up-and-down leg actions, provided the tying was not done tightly. In championships Cavill, for a while, used this stroke in the last few yards and accomplished what was then a sensational finish. This led to keen interest in the new method of propulsion through the water and soon after, when Alex Wickham arrived from his island home, an utter stranger, but a more highly finished crawl-stroke swimmer than any exponent in Sydney, the stroke was fast becoming popular for the short distances."

HOW AUSTRALIA FATHERED THE CRAWL

"That the crawl theory or principle is a production of the Pacific and Southern seas is little doubted. The development of the stroke, however, and its demonstration to the world at large, is absolutely attributable to Australians. Cavill demonstrated this stroke in England during 1902 and Kieran in 1905, though a trudgen swimmer showed C. M. Daniells, American champion, H. Julin, Swedish champion, and other leading swimmers, the principles involved. The stroke during these years had been given much practice and study, and persons traveling from Australia to other lands, if at all interested in swimming, made it more generally known. Thus we

have the spread of the crawl and the subsequent Olympic and world-record-breaking results.

"In the early days of the crawl the stroke was found most exhausting, chiefly because the leg actions were confined to two distinct and muscular flips of considerable power with the feet in composite action or timing to the arm stroke. Today over all or any distances the crawl stroke is swum with a more rhythmic action of the legs than the old crawl stroke.

"The styles accepted as standards nowadays are the six-beat or American crawl and the trudgen crawl. However, these two varieties are and can be subdivided or classified by such terms as four-beat crawl, six-beat crawl, eight-beat crawl, single-trudgen crawl, double-trudgen crawl and so on. These varieties are definitely noticeable to the expert However, the development of the crawl is laid to certain well-defined principles that have been evolved and maintained by swimming coaches. These principles, which are mostly based on an elimination of negative or retarding actions, are fairly wide in scope.

"No better illustration of this can be afforded Australian readers than to take the contrast in style offered by Andrew Charlton and Noel Ryan. Readers will remember that Charlton beat Ryan by two feet in the quarter-mile race recently in Sydney, and in the return race here in Melbourne less than a fortnight later, Ryan beat Charlton by a fingernail. Charlton's stroke has all the appearances, except when he is sprinting, of a 'classy' trudgen swimmer of a decade or more ago except that his stroke is governed by all that is known of the crawl-stroke methods in the elimination of negative actions. For instance, Charlton has a fairly wide scissor kick such as was used in the old Australian trudgen-timing method, but this kick is done without any undue bending of the underneath leg, as was the case in the trudgen stroke; and without any undue thrust of the top leg. In fact Charlton's leg effort is mainly confined to the lower shin and instep. Again, Charlton uses his right-arm thrust just before pulling it through the water, the same as the good trudgen swimmer did. Charlton, furthermore, is practically a one-sided swimmer in so much that he looks almost wholly to only one side during a race and gets greater power, that is, covers more water on the right side than on the left side. This was a trudgen-stroke characteristic.

"Ryan, on the other hand, is a balanced swimmer so far as arm work is concerned. As regards the position of the trunk he is doing the same work on one side as on the other. He rides slightly higher and with better balance on the surface of the water than Charlton does. He can look both

ways right throughout a race. These two famous swimmers look awfully unalike, yet both are endeavoring to observe the same principles.

"A great Australian swimmer of international fame, the late Cecil Healy, once said, 'No two swimmers will swim exactly alike in every particular.' This is so very true that swimming enthusiasts are apt to be led away from the cardinal features of what makes for a correct fast-swimming stroke. Weight, height, reach, floating ability and other physiological factors all tend to make one swimmer look so much different from another and have to be taken into consideration when coaching a promising exponent.

"Takaishi, the wiry and tiny Japanese champion who was out here in 1927, was extremely flexible and practically double-jointed, swimming in all essentials a very correct and true six-beat crawl stroke, except on the right-arm recovery. Here he recovered with an extremely high lift of arm from the water and turned his left shoulder very deeply. A good swimmer of a different type of build from Takaishi, could not have performed this action and been successful or extremely fast.

"Norman Ross, six feet, three inches, and fifteen stone (210 lbs.) in weight, performed a very wide major, practically a trudgen, scissors kick in his method of crawl-stroke swimming. A smaller man attempting the same kick would not have been able to have properly synchronized the stroke and would undoubtedly spoil any chance of fast times by the fact that a wide kick would, with him (a short man), become a distinctly negative action.

"For sprint swimming the two best exponents for style whom I have seen are Duke Kahanamoku and John Weismuller. In sprint racing, both swim six beats of the legs to a complete cycle of arm actions, that is, a right and a left arm pull.

"John Weismuller has done 51 seconds for 100 yards swimming under International record conditions. This is practically six feet per second and represents a drop of over twenty-five seconds since 1878, when the record was 76¾ seconds. That 50 seconds will be broken is a foregone conclusion in my opinion. Equally, so will all present middle- and long-distance records be broken.

"Duke Kahanamoku is the most colorful personality who ever entered the swimming arena. Over six feet tall and a modest but thorough gentleman, he was immensely popular everywhere, for he was most playful and charming. When the moment demanded it, however, he was a stern opponent.

"Able contestants are now experimenting in eight- and ten-beat crawl

strokes, and while this number of leg actions seems unnecessary and unwieldy, who can say that championships of the future will not be one of these strokes? The science of swimming is progressing and today's methods may soon have to be discarded.

"The Japanese successes at the recent Los Angeles Olympiad have taught that a much quicker recovery than was previously in use can be adopted with success. Three other points of the Japanese stroke are: (a) recovery of the arms can be made in any loose-muscled manner; (b) that the hand need not be flat on making the thrust or placement of the hand into the water after recovery; and (c) that a long pull through (before lifting arms in recovery) is unnecessary. These features will no doubt be adopted almost universally and with their adoption swimming times will improve.

"The actions of the arms in the various crawl strokes are practically the same as for the old trudgen stroke, that is, both arms used alternately in recovery above the surface of the water.

"The basic unit of crawl leg action is a small scissors kick, an up and down flutter of the legs, effected with the knees almost straight and the feet and toes pointed, yet without moving in a harsh muscular action. In a way the action may be likened to that of the ballet dancer, moving on tiptoe with a very short stride or running action. The legs work alternately and continuously, thus performing a steady flutter or thrash."

SIX-BEAT CRAWL

"In the six-beat crawl the leg flutters are narrow and even. There is no accented timing and the width of the feet openings as the legs flutter is from six to twelve inches.

"In the trudgen crawl, one fairly wide scissors kick is made slightly sideways, followed by one or more leg beats or flutters of about six inches each. The width of the major kick may go to twenty inches. The one great mistake to avoid is kicking too vigorously. It is not necessary to raise great strength to flutter the feet and legs. In fact the contrary is the case. Undue exertion tires and stiffens the muscles and so makes rhythm or timing difficult."

FAULTS

"The most prevalent fault that one sees in devotees' practices is that they bend excessively at waist and knees. Of course excessive rigidity is to be avoided. This is just as bad a fault as extreme flexing or bending of the

legs. There is always that happy medium that swimmers must discover by thoughtful practice.

"Although the whole leg in a sense lifts slightly and the thigh is used, the real positive action is made with an instep movement or kick, and I have found in coaching that practically the only way to get a swimmer to fall into the correct action is to tell him that the message from the brain is carried to the instep only. When they are using the instep to kick with, however, there must not be any rigidity in the knee and thigh."

CORRECT MOVEMENT OF ARMS

"As mentioned before, the arms work alternately, much as in the old over-arm trudgen stroke. Each arm enters the water for its drive or pull with the elbow a trifle higher than the hand; the hand in recovery is held naturally, not stiffly, fingers together and palm down. A comfortable reaching-out only is used by each arm. Gentle downward pressure is maintained as soon as the hand reaches the water, and while the arm is still going forward, and after this has served to lift the shoulder the arm is drawn down and back fairly vigorously. The arm pulls under the body until the hand is about to strike the thigh, then the hand moves outward till it reaches the surface, when the entire muscles of the arm are relaxed. At this moment the hands are turned almost palm down and allowed to droop at the wrist—this facilitates complete relaxation. Next, the forearm moves out and round until it is pointed almost straight ahead and moving forward, then commence stroking forward once again. The elbow does not start moving forward until the forearm has gone into the lead of the shoulder. It is all-important to see that the forearm completes its semicircle reasonably quickly on leaving the water and is directed forward before the elbow starts ahead.

"One should aim in swimming the crawl stroke to hold the shoulders on a reasonable level as much as possible. In turn, each shoulder is bound to submerge a bit, but at no time should it be allowed to submerge deeply below the surface. Both shoulders can be best supported by making sure that each arm starts its drive with firm pressure before the other arm leaves the water in recovery.

"Rolling of the body from side to side is a bad and costly fault that must be eliminated by any swimmer before he can hope to become of the first flight.

"Except in the act of breathing, in when that act is almost a gasp or quick take-in of air, the head is held naturally without strain, and as much

as possible on the same level. It should not be raised or lowered except to take a very occasional glance at the course or the field of competitors.

"The general action of the crawl is smooth. One must drive with pressure, of course, but the recovery of the arm is done with relaxed muscles. The power of the arm drive applied at first, next a powerful sweep as the arm passes the body. Then a lessening of the applied power but not completely, and with no loosening of one's hold (as it were) on the water till the other arm has commenced leverage.

"In recovery never swing the arm out of the water with force. It is a waste of energy and very upsetting to body balance of rhythm.

"Swim easily always, concentrating successively on each of the several parts of the stroke. That is the shortest road to proficiency in learning or improving your crawl stroke or swimming ability."

For further history we go now to an American source, "Science of Swimming" by Frank J. Sullivan, the man who was the originator of the American trudgen crawl, and who had a long and successful career as a swimming coach from the very beginnings of crawl-stroke swimming in this country to the present time:

"The original crawl stroke was evolved in Australia, hence the name Australian crawl stroke. As related by L. deB. Handley, one of America's foremost authorities on swimming, the stroke was originated as follows:

" 'Tums Cavill, a member of the world-famous family of swimmers, was matched to meet Syd Davis at 50 yards, with legs tied, and beat him, only to be defeated later by the same man at the same distance, after the legs were untied.

" 'Dick Cavill was present and refused to believe what he saw, but a few private time trials convinced him that his brother could really sprint faster without the use of his legs and this started him thinking. He reasoned that every ounce of power properly applied must resolve into an increase of speed, so that the scissors kick must be radically wrong. The question was to find the right one. Then he remembered having seen Alex Wickham, a fast young Rubiana sprinter, use an odd straight-legged kick, which he had learned from the natives at Colombo, in Ceylon, and decided to experiment with it. The result surprised him, as the kick proved speedy from the very first trial.

" 'Unluckily the difficulty of finding an arm action that would harmonize bothered him considerably, and by the time Dick Cavill found it the one-hundred-yard championship was only a few days off. He entered,

however, anxious to give his find a public trial. Those who followed swimming at the time may remember the race. Starting out at a terrific pace, Cavill reached the fifty-yard mark fully five yards ahead of his nearest competitor. But here the imperfectly mastered stroke began to tell on him and he gradually died away. A few feet from the finish he was passed by the speedy Bishop.

"'Notwithstanding the defeat, this performance gave the coaches an estimate of the value of the new stroke (which peculiar action won for it the title of "crawl") and they took it up immediately, forming classes to teach it. Their success was marvelous. Men who had been but indifferent swimmers came to the fore, good men improved and soon the world was ringing with news of the great work of the "crawlers." Al Wickham at Rubiana swam 50 yards in 24 seconds with it, and then Dick Cavill went his phenomenal hundred yards in 58 seconds. The stroke soon invaded Europe and eventually it reached to America, where it was taken up in 1904.'

"This is the best description of the origin of the crawl that ever has been published. Today the Australian crawl as used by Wickham and Cavill is obsolete. It has not been used since the Olympic contests at London in 1908, where the American type of crawl was used so successfully by Daniels and Hebner of the American team. The legless crawl as used years ago by H. J. Handy of Chicago, although a big improvement on the double overarm in the matter of speed, has also given way to the more modern method.

"The original Australian crawl was a very awkward stroke, considering the fact that the kick was timed with the arm stroke as follows: when the right arm was reached forward the left leg, held stiff and only bent at the knees, was kicked downward; when the left arm was reached forward the right leg was kicked downward. As a result, in order to get the utmost speed, the reach of the arms was curtailed so that the catch was made on a line with the shoulders. This stroke had no retarding movements such as the drawing up of the legs as in the scissors kick used in the double overarm, and naturally proved a faster stroke, but it could be used only for short distances, due to the faster and tiring arm action."

Our next bit of the history of swimming comes from C. M. Daniels, the first great American swimmer of international repute. Daniels won many races in England and on the Continent, and was the world's record holder in the sprints and won Olympic Championships at St. Louis in 1904, at Athens in 1906 and in London in 1908. The quotation below is from his book "Speed Swimming" and describes the crawl.

"This stroke, which experts have come to look upon as the stroke of

the future, is a combination of an abbreviated overarm and a peculiar leg drive learned by the Australians from the natives of the South Sea Islands. The leg drive cannot be called a kick; it is a continuous up and down alternate thrash of the lower legs from the knee down. In Australia the action of the arms and legs is synchronous, that is, the right arm comes back as the left leg goes down, and vice-versa. In America, with few exceptions, the arms and legs are worked independently and the thrash has a narrower scope, the legs being opened less.

"That our system is the best seems undoubted, if theory counts for anything in swimming. Mr. Robert Sandon, whom I consider one of the world's leading authorities on aquatic matters, explains the reason in a manner that I think convincing. He asks us to watch the flight of a flat stone that has been thrown hard along the surface of the water, and to note its progress. So long as the flat side strikes the water it bounces on without a check until its momentum ceases. But, let even the smallest portion of it become immersed and it is brought to a sudden stop, its flight checked instantly, never mind how great its speed. Apply this to swimming now. In the trudgen, or even in the Australian crawl, when swum easily, there is a time when the propelling forces pause, the body sinks lower in the water and a check is noted; in some swimmers a very decided one. In the American crawl, instead, the continuous action of the legs keeps the body constantly in motion, so that there is no check or sinking and the stroke must perforce be faster. Of course, in sprinting with the Australian crawl the pause is so infinitesimal that there can be little advantage over it in the American stroke, but as it is very probable that eventually we will use the crawl for all distances, the point is not to be overlooked. A small number of Americans have adopted the Australian stroke, with its wide and synchronous thrash, but have added a fluttering of the feet between arm strokes, which makes the action continuous.

"The relative time of the arms and legs, in the American crawl, can best be determined by the individual or his coach; one with strong arms and weak legs can adopt a rapid arm motion and a slow kick; one with strong legs can do the contrary. This is one of the stroke's best features, for it can be fitted to each person. Some of our best men use the arms almost entirely, and one at least, Mr. H. J. Handy, of Chicago, lets his legs trail behind him. He tried the kick, but found he could not swim without tiring when using it, so he abandoned it. Others can go almost as fast with legs alone as when using the arms.

"A good deal of discussion has been raised in regard to whether the ankles should move or not in the crawl. Mr. Gus Sundstrom, instructor at

the New York Athletic Club, who was indirectly responsible for the introduction of the crawl in America and who has more speed with the leg drive alone than any man I have seen, not only bends the ankles back and forth, but he says it is by doing it that he gets his wonderful speed. His drive is more of a pedaling motion, he brings the toes up as the leg rises and points them down as the leg snaps back. A few of our swimmers also move the ankle a little, but most of them keep it rigid. At the present stage we cannot say positively which is the better method, but from Mr. Sundstrom's success we should say using them is.

"There are as many varieties of the crawl nowadays as there are men using it. No two swim it alike and each indulges in a little experimenting of his own. This will gradually lead to progress, and it is probable that as the men discard the inefficient details in favor of the successful ones, the different varieties will condense into definite strokes from which the best will eventually be picked."

In closing, here is a quotation from Cecil Healy, one of the great Australians whose reputation as a competitive athlete was world-wide. The authority for his statements is "Swimming and Swimming Strokes," compiled by F. Baxter, issued by the Amateur Swimming Association, published by Simpkin, Marshall, Hamilton, Kent & Co., Ltd., London.

"The 'crawl' stroke has much in common with other methods of propulsion: No two persons swim it exactly alike in every particular. The broad principle, of course, is the same, but there is always observable some individual peculiarity of adaptation, just as in the cases of fingerprints, dissimilarity of detail is perceptible.

"But there is really no occasion to be surprised at this. One needs only to make a superficial study of the mechanics of the thing to realize how perfectly natural it is, and that it could not very well be otherwise.

"In the first place we must bear in mind that flotation is simply the art of balancing the body on the surface of the water. Its weight, width, size and dimensions generally are all factors that affect the scales, as it were, and alter its center of gravity. Very well, then. As we also know that human frames differ, not only in parts, but in the sum total, it stands to reason that if a specific set of movements is appropriate to one form, it cannot, of necessity, be absolutely suitable where another is concerned. In other words, it is an individual equation, and the problem that confronts a person who is desirous of attaining speed is to find out what styles answer his own requirements best.

"Nature does not conform to the principles of Socialism; otherwise there would be no discrepancy in aptitude or ability and the choice of actions could be left entirely to her. But, as a matter of fact, she is most unreliable in this respect, and more often than not it is necessary to check her tendencies in order to achieve the object desired. In other instances, she is unaccountably prodigal in the bestowal of favors, thereby producing what we term a genius, who is developed without any artificial aid whatsoever. We, however, are not dealing with the great exceptions to the rule, because they have no bearing on what happens in the ordinary course of events.

"What we have to concern ourselves with is that which transpires usually, in which case it is undeniably possible, as is proven every day of our lives, to bring brain power, allied with experience, to bear in such a way as to perfect, develop and improve natural inclinations. That is why it is invariably advisable to take advantage of instruction, if it is available from a duly qualified source, because once a bad habit has been acquired and practiced, the longer it is allowed to remain unchecked, so much more difficult does it become to subsequently eradicate it. Tutorage, therefore, constitutes a sort of insurance against the risks referred to.

"There are two distinct modes of 'crawling' in vogue at present, and its exponents can be said to consist of four classes, namely, those who breathe regularly and those who take four or five strokes before replenishing their lungs, and those who strike with the right arm, left leg alternately, and vice-versa, and those who have an independent leg action.

"Exponents who do not breath regularly lie flat, with head down, shoulders square, face submerged and use a short paddling arm action. The effect of keeping the head lowered is to float the legs as high as possible, the body thus lying in a horizontal position near the surface, which enables it to skim along. Undoubtedly, great speed can be attained this way, but holding the breath for the length of time necessitated causes the physical exertion to become much more acute and exhausting. Its range of effectiveness is therefore limited, particularly in open water. Under the latter conditions, those who swim as described show a great slackening off in their rate of progress after 100 meters have been covered, compared with what they are capable of doing up to that distance. Some who are tremendously fast for a sprint are absolutely unable to keep going for as much as a couple of hundred yards at a stretch, even slowly. The greatest thing that can be said in its favor is the fact that most of the world's fastest short-distance performers swim in this fashion.

"Duke Kahanamoku, the famous Hawaiian, for instance, only breathes every fourth stroke. Daniels, another wonder of the age, likewise only

snatches a breath periodically; in fact I do not know of any American who differs in this respect.

"In small baths, in which they learn and mostly compete, it is not nearly so tiring, because the momentary pause at the turn enables the system to recuperate some of its lost strength and the push off more than compensates for the delay in getting round. Consequently, much longer journeys can be negotiated and quicker times recorded in these circumstances than when the course is a long one.

"Another drawback attached to swimming with the head lowered is the difficulty of steering a straight course. Nearly all indoor tanks on the other side of the world have thick, black lines painted along the bottom, running from end to end, which are clearly visible even in the deepest part, and overcome the objection, as far as they go. But at Stockholm, where there was no such guide for them to rely upon, the Americans frequently deviated and swam crookedly, occasionally bumping other competitors.

"It is granted that they are exceptionally fast, but is it not feasible to think that they, and others who affect this style, would be able to maintain their maximum rate of speed for a greater length of time, if they succeeded in acquiring the knack of obtaining breath more frequently, without interfering in the least degree with their momentum?

"As has been proved beyond all doubt, the crawl is a style of swimming indigenous to the South Seas. With the exception of Kahanamoku, all the natives the writer has seen in the water seized the opportunity of securing fresh air every stroke of the right or left arm, according to how it suited them. This is done by flicking the face sideways, just as the arm has reached its full extension and is about to take a downward course.

"Practice enables this to be accomplished without throwing the head back or altering the position of the body. In this method the shoulders are brought much more into play by a rolling movement from the hips, which reduces the strain on the body, acts as a propelling force and brings about a gliding motion.

"I maintain that this is really an advanced stage in the evolution of the practicability of the stroke for other than 100-yard dashes. Years ago, when the potentialities of the crawl were first discovered and popularized by the Cavills, it was only utilized for putting on an extra spurt over the last few yards at the finish of a race. At that time, everyone here swam in the way that the Americans do now. Then the breathing difficulty was successfully surmounted and the distance over which it was used gradually increased, until we find it employed today for the purpose of establishing fresh records for three-mile swims.

"The ideal stroke, of course, is the one that gives the maximum of propelling power with the expenditure of the minimum of physical exertion. A fundamental principle of the crawl is to float in such a way that the muscles are relieved of the strain of maintaining the body in the required position. This result is achieved by swimming with them relaxed, except at the instant it is necessary to bring pressure to bear to continue the forward movement. As it is so much a question of balancing the frame at a clearly defined angle, it is only natural that the depth of the water is an important consideration and plays a big part in influencing the action of the limbs necessary to that end. The legs and feet combined assume the function of a gyroscope in the adjustment of the body. Salt water being very buoyant, not much assistance is required from this source to keep it posed horizontally. Therefore one kick with the legs to every arm stroke is found sufficient for the purpose. But in fresh water the legs and body sink much more rapidly and consequently additional support is essential.

"The Americans and other exponents who learn in fresh water invariably have an independent leg action, and kick two or three times to each stroke with the arms, and the writer opines that they did this quite unconsciously in the first instance, and that it is not the outcome of a special study of the subject, but simply a case of nature adjusting herself to altered conditions.

"When an infant is put in the water for the first time its limbs describe the movements in a crude form, and undoubtedly the best way for a youngster to be taught is simply to allow him to 'dog-paddle,' and then afterward encourage him to lift his arms clear of the water. It is much easier to learn the trudgen or side-stroke later on, than it is to commence with one or other of them and then tackle the crawl.

"A grown-up person who is anxious to adopt it, and has been used to kicking scissorslike, finds that his greatest difficulty is to keep his legs extended out behind and move them up and down instead of sideways. I therefore recommend the following as the quickest means of acquiring the habit, namely, having taken a deep breath, lie as flat as possible on the surface of the water, lower head well down, place hands alongside hips, or straight out in front, thumbs locked, and then kick the feet rapidly up and down, just bringing them clear of the water and striking with the instep. Start a yard or two from the steps of the bath and try to reach them before lifting the head. After a little practice this can be easily and quickly done.

"Generally speaking, it prepares all the muscles of the body for their new work and use, besides doing away with the awkward feeling of keeping

them in that position, which every person experiences who is unaccustomed to kicking them in this fashion. After having undergone this training for a little while, the proper stroke can then be attempted more intelligently as a rule. It is advisable to start off with a push from the side of the bath. The head should be again lowered, the arms bent at elbow, thrust just beyond the face and fully extended under water as they go round. The pressure must be taken off as they are about to come up. The movement is exactly the same as that of a duck's leg when swimming. The legs, above all, must not be allowed to separate, but should be worked close together. The whole limb is moved, but the lower portion more than the upper.

"The beginner should try to flick the instep as much as possible, as he will have found out by practicing the exercise alluded to, that more propulsion is derived by this action than a stiff leg movement. Beyond that, I am inclined to believe that the other details of the kick, such as length of thrash, how far to lift them out of the water, etc., can be left to one's natural inclination. It is not advisable to try and breathe regularly at first. The learner should concentrate his attention on mastering the general movements. When obtaining breath, the face should be twisted round, as previously stated, but the head thrown back, ever so little, as the tendency is to sink the legs, and when this is done they act as a drag. Once the proper action has been acquired the rest is merely a question of practice and perseverance, the rate of improvement and advancement being determined entirely thereby."

It is a far cry from the early two-beat Australian crawl to the comparatively smooth, even six-beat crawl of the present day, but even now we are a long, long way from perfection. A great many people believe that we've only scratched the surface in the possibilities that exist in this type of locomotion in the water. With greater facilities, more opportunity for younger people especially to grow up swimming as it were, greater facility in the water will be developed. With but a few outstanding exceptions, even so-called good swimmers are mere neophytes in the art. There are so many interesting angles to swimming that the coaching of this sport is most exciting. The development of facility in the water, generally, is limitless and the development of swimming as a competitive sport has tremendous possibilities in the future.

As a great competitive activity it is in the front rank, and as a universal activity in such great international contests as the Olympic Games it is

second only to age-old track and field sports. From a general physical-education standpoint, swimming is almost an ideal exercise. Probably the most interesting comment that could be made on the activity is the report of the Committee on Curriculum Research of the American Physical Education Association, as reported in the May, 1930, issue of the Research Quarterly.

This committee in conducting its first year's study sent out rating charts to a selected group of experts composed generally of college directors, supervisors and some large-city supervisors. Approximately fifty per cent returned the charts, so the study was based on the estimates of forty men. It was assumed that the opinions of a few outstanding leaders would be better than a large number of opinions from poorly trained people.

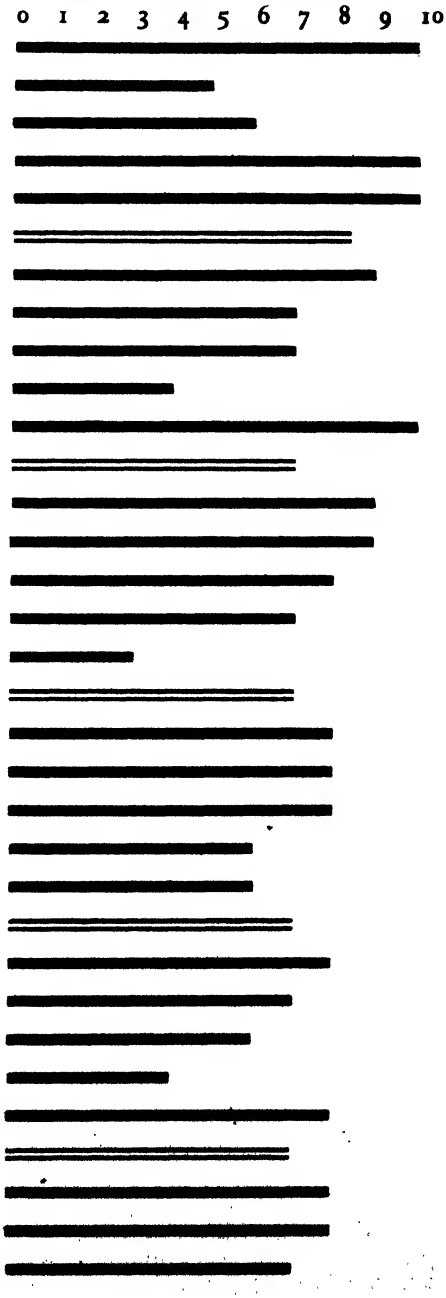
On the conclusion of the study, swimming easily topped the entire list in all-round contribution with a medium score of 10. All readers were sent a detailed set of instructions on how to score the charts and the scoring was done on an evaluation of zero-10; zero representing no contribution, 10, maximum contribution. The rating provided for the following evaluations:

One, the contribution to the physical and organic growth and development, and improvement of body function and body stability (physical development); two, the contribution to the traits and qualities that go to make up the good situation in the development of sound and moral ideals through intensive participation under proper leadership (social development); three, the contribution of the activity to the psychological development of the child, including satisfactions resulting from stimulating physical and social experiences (psychological development); four, contribution to the development of skills that increase the individual's capacity for protection in emergencies, both in handling one's self and in assisting others (safety development); five, the contribution to the development of skills that have a distinct function as hobbies for leisure-time hours, both during school and in after school life (recreational development).

The following pages (18-22) show comparative charts of the relative contribution of activities, ranked in order of importance on the basis of all-around score. Swimming headed the list with a top score in the physical contribution, safety contribution and recreational value. Its lowest contribution was in the social scale, with a psychological contribution rating at about the same scale as most of the individual sports, such as squash, tennis, golf, boxing, and other individual activities.

CURRICULUM RESEARCH—
BOY'S PHYSICAL EDUCATION PROGRAM—CHART 10

COMPARISON OF RELATIVE CONTRIBUTION OF ACTIVITIES RANKED IN ORDER OF IMPORTANCE ON BASIS OF ALL-ROUND SCORE (AVERAGE OF MEDIANS).



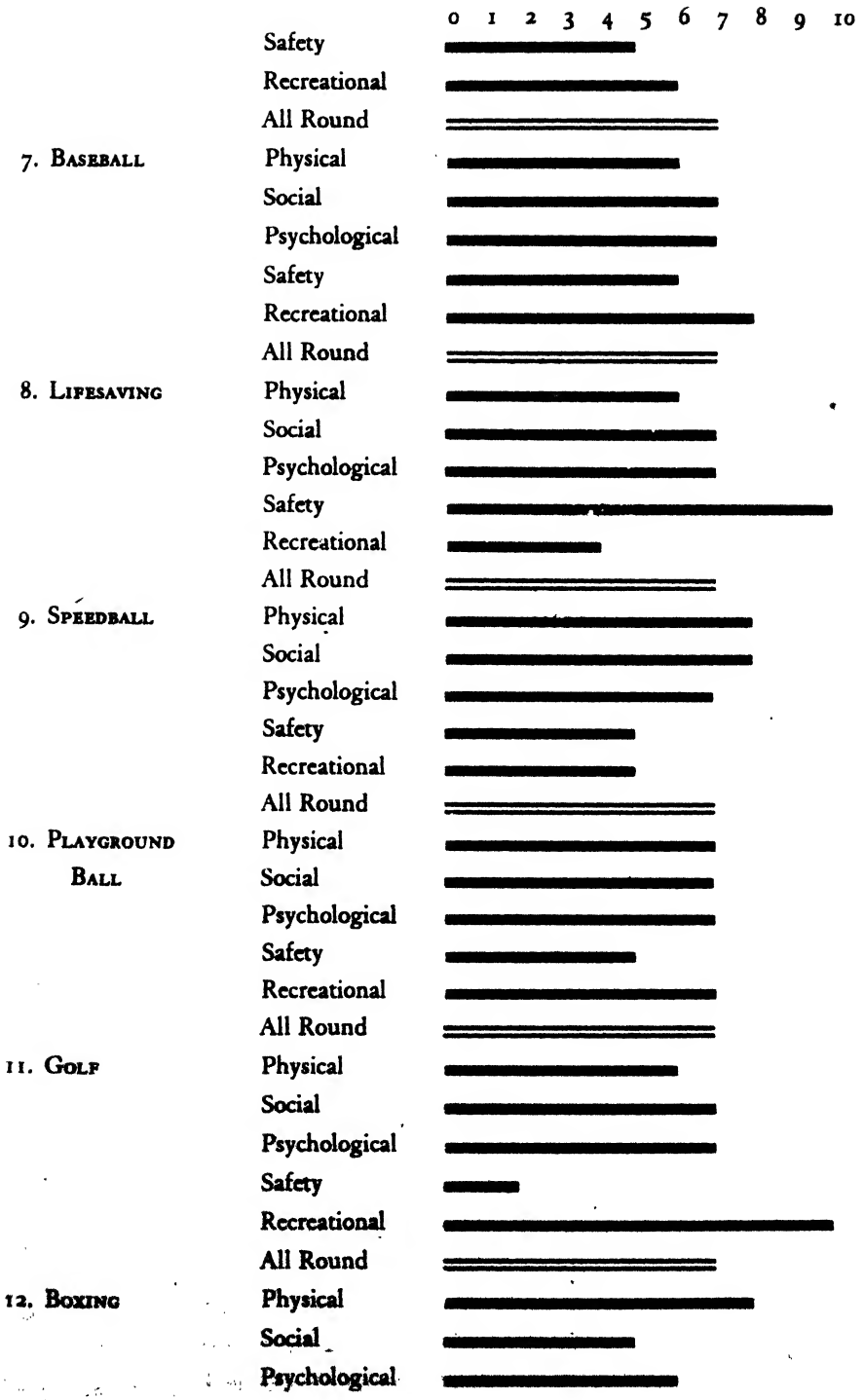
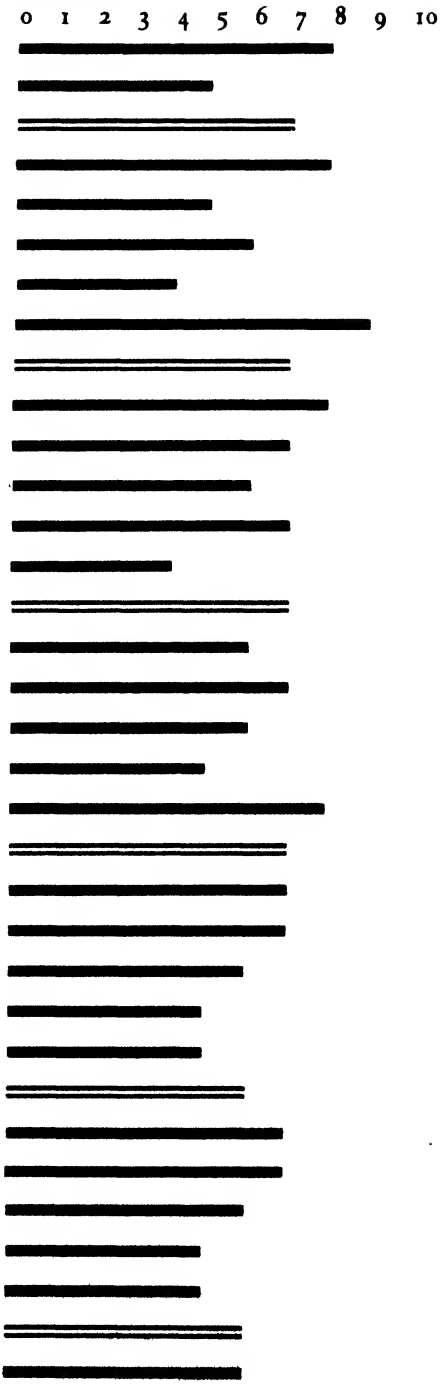

0 1 2 3 4 5 6 7 8 9 10
Safety
Recreational
All Round
7. Baseball
Physical
Social
Psychological
Safety
Recreational
All Round
8. Lifesaving
Physical
Social
Psychological
Safety
Recreational
All Round
9. Speedball
Physical
Social
Psychological
Safety
Recreational
All Round
10. Playground Ball
Physical
Social
Psychological
Safety
Recreational
All Round
11. Golf
Physical
Social
Psychological
Safety
Recreational
All Round
12. Boxing
Physical
Social
Psychological

CHART 10. *Continued*



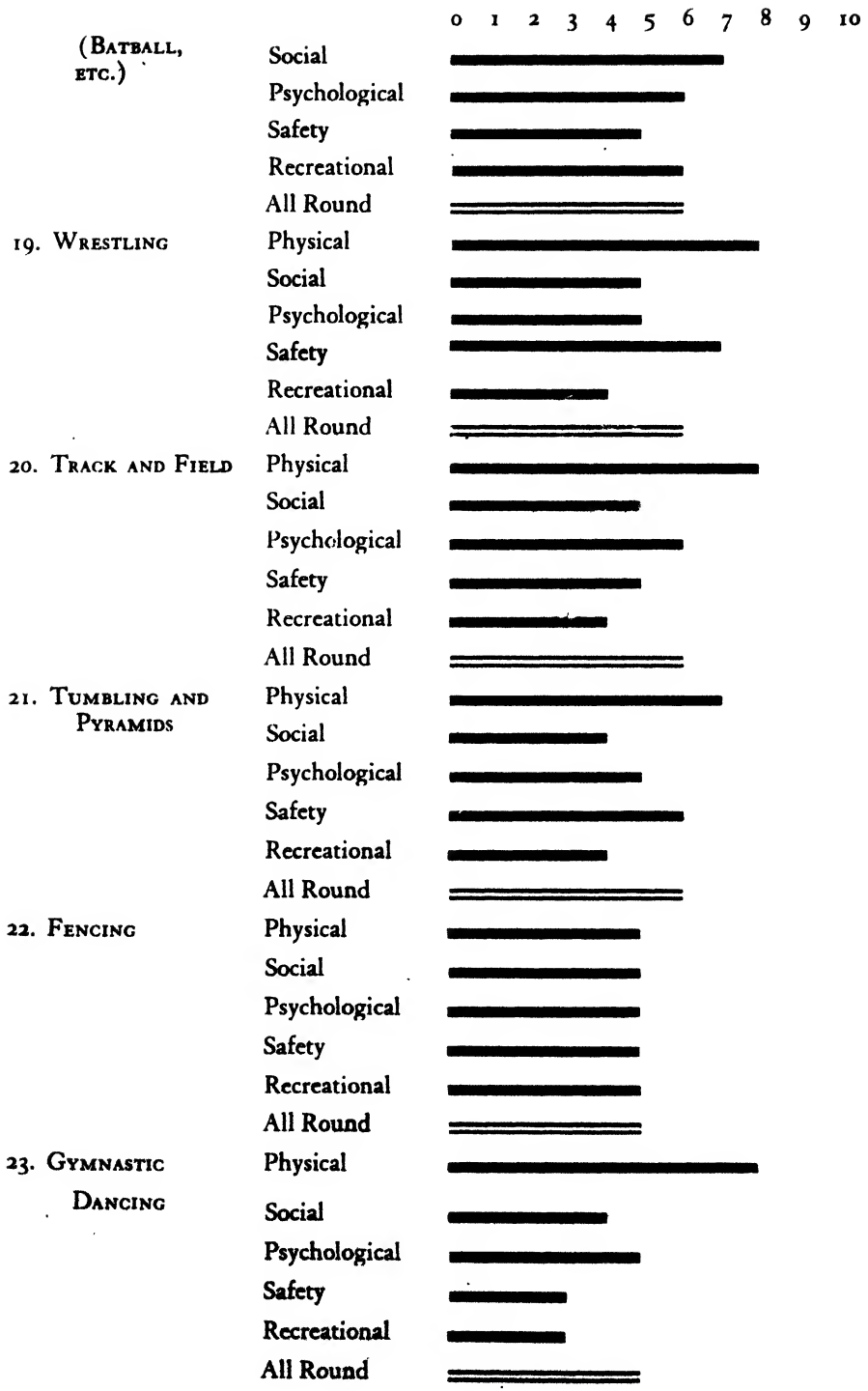
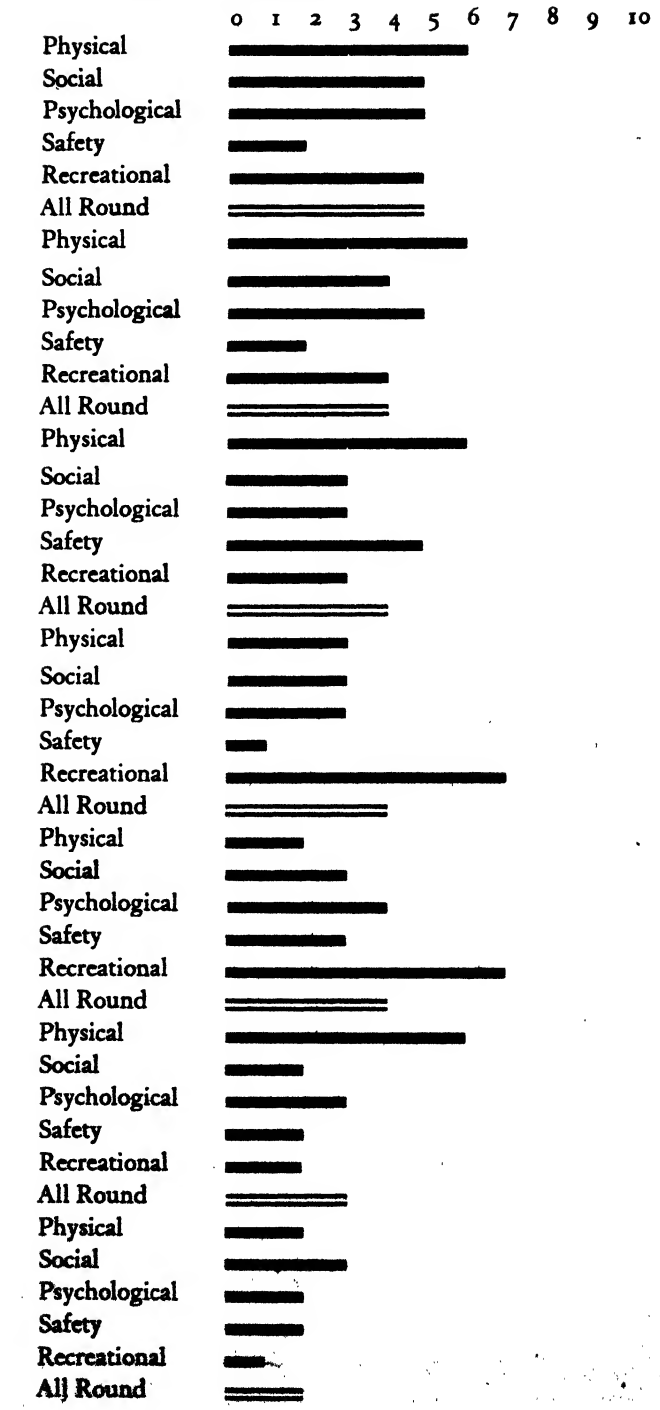

0 1 2 3 4 5 6 7 8 9 10
(Batball, etc.)
Social
Psychological
Safety
Recreational
All Round
19. Wrestling
Physical
Social
Psychological
Safety
Recreational
All Round
20. Track and Field
Physical
Social
Psychological
Safety
Recreational
All Round
21. Tumbling and Pyramids
Physical
Social
Psychological
Safety
Recreational
All Round
22. Fencing
Physical
Social
Psychological
Safety
Recreational
All Round
23. Gymnastic Dancing
Physical
Social
Psychological
Safety
Recreational
All Round

CHART 10. *Continued*



Physical Equipment and Tests

THE POOL

ALTHOUGH SWIMMING can be done in open water, the development of competitive swimming depends on extremely favorable conditions, as only well-designed, well-operated swimming pools can afford. The difference in conditions between swimming in open water and in swimming pools can be compared to the difference between cross-country running and track running.

The swimmer must be afforded advantages that only the pool can give; a course of known length, smooth clear water and well-defined lines on the bottom of the pool, ending in distinct cross-markings that indicate the approach of the turning end, as well as distinct markings on the end of the pool. There should always be a starting platform eighteen inches above the water. Hand grips should be provided for backstroke swimmers to aid in the start. The pool water should be of the correct temperature, and a comfortable auditorium temperature and humidity must be provided at all times. These aids to the swimmer, which are so necessary to good performance, are overlooked so many times that they must be emphasized over and over again.

The items just enumerated should be found in all recently built pools, and to be had in old pools with very little additional expense. Their absence is due to carelessness or more often to lack of knowledge of how to secure them. Even today there are many pools that are used a great deal for competitive swimming, and which do not have these essential items.

To elaborate a little on the above-mentioned requirements; smooth water with very little wave action is one of the greatest aids to the swimmer. Rough water makes breathing difficult and also causes a great deal of friction that has to be overcome. Smooth water is the result of having the water at the gutter-lip level. Starting, swimming, turns and other body motions stir up much wave action. When these waves hit the angled back wall of the gutters they are flattened and dissipated. If, because of open-gutter drains the water level falls considerably below the edge of the gutter, the waves hitting the flat inside wall of the pool are immediately thrust back into the pool, adding more and more to the friction that the swimmer must

overcome. If it isn't possible to provide the gutter drains with valves to shut them off, or if the gutter drains cannot be tied up with the filtering system so that no water is lost, a very easy and economical way to shut off the drains, especially during competitions, is to place large bath towels over the drains, covering them with some heavy object to hold the towels down. Very little water is lost by this method, although it naturally isn't as good as providing the drains with shutoff valves.

The next item almost as essential as smooth water is clear water and guiding lines on the bottom of the pool. With the knowledge concerning efficient pool operation available at the present time, the water in all pools can be and should be practically colorless at all times, and the correct chemical content should also be maintained.

All pools should have broad guiding lines at least a foot wide on the bottom of each swimmer's lane, with a distinctive cross-marking four or five feet from the end of the pool to indicate to the swimmer that he is approaching the turn. It is very easy to paint lines not only on cement but also on vitreous and glazed tile. In pools where there are no lines or where the lines are narrow (less than one foot wide), or where lines look narrow by having the center portion of the stripe a dark color fading out to a lighter color at the edges, it is easy to paint in lines of the proper type. These lines should be of some dark color, preferably black, and of distinctive design. Similar lines can also be painted on the end of the pool as a further aid to the swimmer in making the turns.

MECHANICAL AIDS

In addition to the lines on the bottom of the pool, which are placed in the middle of each swimmer's lane, cork or wooden lines mark the surface boundary of each lane. These lane markers provide the advantage of keeping the swimmer in his course and also aid in keeping the surface water smooth by killing wash close to the original source. Cork is very expensive but wooden markers are comparatively cheap, and line fasteners can also be provided at very little cost if it is found impossible to install screw eyes in the tile end of the pool, especially in pools where original installation has been overlooked.

The temperature of the water should be from 72 to 75 degrees Fahrenheit, and room temperature should be 10 degrees higher than the water. Tests should also be made for humidity. Many times, oddly enough, the heat and ventilating systems of swimming pools don't provide the humidity compatible with health. An absence of the proper amount of moisture in

the air, irritating the respiratory tract, may have a great deal to do with colds, to which swimmers seem to be so susceptible. It is comparatively inexpensive to install equipment to provide the proper amount of humidity.

Although the rules require that a swimmer start from an eighteen-inch-high take-off, there are still pools where this requirement is not observed. If the deck of the pool is not eighteen inches above the water level, correction is simple. It is quite economical to build wooden boxes, bringing the take-off up to the proper height. It is recommended these boxes be at least two feet square. Although the rules recommend that firm starting grips, flush with the end of the pool, be provided for backstroke-swimming starts, there are more pools that do not have these grips than those that do. Here again it is simple to provide a firm grip in the nature of a wooden cleat, flush with the end of the pool, which is such a tremendous help to the backstroke swimmer, who until very recently at the beginning of a race was forced to grip the flat deck surface with his hands like a mountain goat trying to get a foothold.

It might be well at this point to insert a word concerning pool dimensions. Although the building of pools at odd lengths has practically ceased, pools are still being built too narrow. No indoor pool should be built less than forty feet wide and no outdoor pool less than fifty and preferably sixty feet. This urging may seem superfluous, but the records show only too well that indoor pools twenty-five and thirty feet in width are still being built.

Submarine windows should be built into the side or end walls of all new swimming pools. There's not a single teaching aid from which as much benefit can be derived as this latest feature in swimming-pool construction, not only as a great aid in visual observation but a permanent record of the swimmer's position and movements can be made with photographic stills and motion pictures. No scientific study can ever be made of swimming except under water, and it is to be hoped that this latest feature will stimulate scientific study and research in the swimming strokes. The reader is referred to an article by Mr. David Ambruster, Swimming Coach of the University of Iowa, on under-water observation windows, found on page 71 of the National Collegiate Athletic Association's Swimming Guide for 1940.

More recently a new device for recording finishes in swimming races has been developed and the writer feels that it is so near the perfected stage that the story and information concerning it may be offered here in the inventors' (Messrs. Ritter and Jockers)* own words.

* Mr. Ritter is the U. S. representative on the governing body for swimming the world over (Federation Internationale de Natation Amateur—F.I.N.A.).

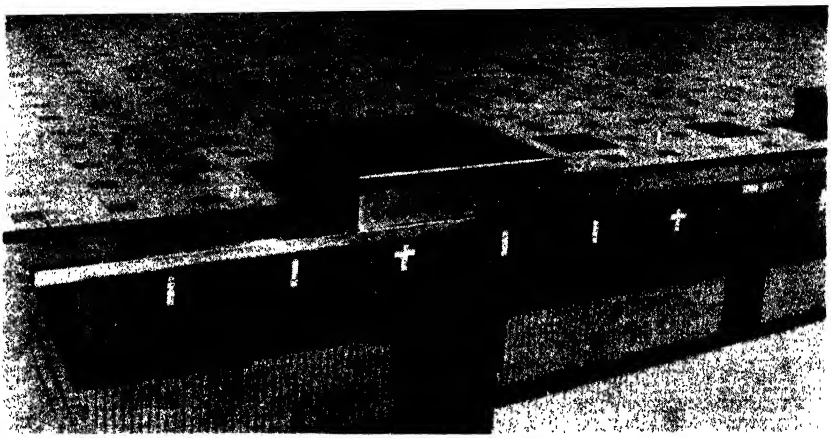
"The old saying that the hand is faster than the eye finds also its great truth when it comes to the judging of swimming-race finishes. Conditions peculiar to our sport, close finishes in sprint races with over- and under-water touches amid a lot of water splashings, make the proper judging of such finishes extremely difficult and often well nigh impossible. No matter if we select the most alert and intelligent judges for our finishes and place them in the most favorable positions for judging on either side of the finish line of the pool at water level or on raised platforms, the limitations of the human eye remain. A finish of a closely bunched field of six or more swimmers cannot be segregated infallibly and often the announced results create doubts, but they nevertheless represent the best that humanly can be done.

"After seeing the many discrepancies in judging finishes, I mulled over the possibilities to judge by mechanical means and decided to try my hand at this problem, which greatly intrigued me. I became the more determined to do this since I was not hampered by mechanical or electro-technical knowledge, which, if I had possessed them, would probably have induced me to construct a most elaborate device. Nor had I ever seen a device for this purpose. The only knowledge I had of such a device was the description given to me by Bob Kiphuth and John Miller of the device used in Vienna, Austria, constructed by an engineer, Kubal, which was very elaborate and quite expensive. I understand it costs about $5,000. I decided to let common sense be my keynote in my endeavors. First of all I set up some criteria of excellence which would have to be met by a finish recorder, listing same in the the order of their importance:

(1) The device has to be within the financial reach of the ordinary college or club.
(2) It has to be applicable to existing conditions found in the average swimming pool, so that no changes in the pool have to be made for it.
(3) It has to be simple and effective.
(4) It has to be mobile; that is, attachable and removable in short order.
(5) It must not decrease the length of the swimming distance, so that there can be no question if a record is made.
(6) It must be so constructed that the competitors cannot be hurt under any conditions by the material used or by electric shocks.
(7) It must be rugged, standing up under regular wear and tear.
(8) It must be a self-contained portable unit, not depending upon outside electric currents.
(9) It must give a permanent record of the races, which could be referred to.
(10) Material in its construction must be durable, rustproof and impervious to chemical action (alkalis, alum, chlorine, etc.).

"Reviewing these standards of excellence, I figured that I had set myself a tall order, but decided to try and to try again and again if I did not succeed the first time, which, of course, I never expected I would. I chose myself a collaborator of excellent mechanical ability, Mr. Harry Jockers, and together we plunged into the problem. We thought we might just as well tackle the most difficult problem first, the recording device, but as we went along we found that the recording problem was comparatively easy, compared with the problem which presented itself when we worked on the contact device for the pool. We decided to construct the best our brains could devise, knowing full well that there would be a lot of shortcomings, but then to proceed from there by elimination and improve our device step by step. This spring we demonstrated at Yale our first ideas of recording and contact. While we were fairly well satisfied with our recording device, we were very critical of the contact device for the pool. However, we decided to gather experience and left the contact device for several months in the Yale practice pool, in order to study its practicability and the strain and stresses on the material itself. The contact device, a double screen on tubing, was given a lot of abuse for two months and stood up remarkably well under the circumstances. It told us a lot and we learned where the weak spots were and what had to be improved. On basis of these experiences we have constructed now this device, which please consider only as the next step in our work and not as the completed article. I wish to say that we want to consider all of you as our collaborators, who by sound criticism can advance what we try to achieve. In this respect I wish to say to all of you, in order to put matters straight on my part, that I do not expect to make any money out of this device, if we should succeed in perfecting it to a point where it will be 100 per cent practical. It should be a contribution on my part to the sport I love and the associations I treasure.

"Now let me explain this device to you: (Illustration I) Here we have a frame with a screen inside, which is held in place on top by an angular alloy material which fits over the edge of the pool. Special rubber strips hold the screens taut, while in the pool they will be held in place by the screws that hold the cork lane lines. These frames will have to be custom-made for each pool, taking into consideration the various widths of the lanes and other peculiarities of attachment. This frame here is meant for the Yale-pool dimensions. There will be six of such frames for most of the pools. These frames will hang flush with the wall about twelve inches over the water surface and about 24 inches under the surface, to take care of any possible finish touch. The contact is made on a single screen which will be about ¼-inch from the wall, but which will not decrease the swim-



I. The Recording Device — Screen

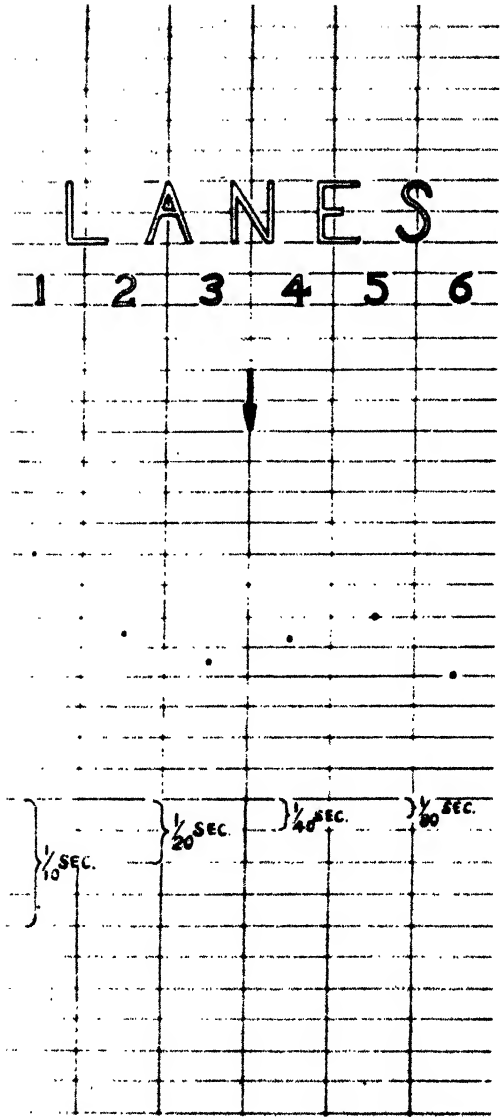
II. The Recording Device — Recorder

ming distance, since the screens are not rigid but give. The push-off at the turn and the finish touch will be at the wall, as the wide mesh will actually permit contact of the body with the wall. The contact at the finish is made through the screen, which is sensitized but which has no electric current flowing through it. No matter where you touch the sensitized screen the impulse is transmitted instantly to a very small foolproof device which closes a current. At the same moment a spark is set off, which registers on the recorder itself. A double touch will not register, as only the first touch or impulse is transmitted, and no second impulse goes to the recorder.

"The recorder (Illustration II) is connected with the frame by a strongly insulated small cable. A spring motor works the revolving drum of the recorder (Illustration III) which carries on its periphery a recording paper. The impression is made on this paper by the spark set off by the screen contact. This small spark is produced by two small batteries, which furnish all the current we are using. The batteries will last a year. We shall have a special detachable paper, ruled into six divisions representing the six lanes. This paper is discolored on the surface by the spark thus giving the record for the race, illustrating by their relationship the respective positions at the finish of the race. (Illustration IV.)

"The circumference of the revolving drum and its respective recording paper is 30 inches. The speed of the drum is one revolution in three seconds. Since the circumference is 30 inches, we have therefore ten inches of paper for each one second. If you divide the paper you get a traveling speed for one inch of 1/10 of a second, for ¼ inch (which is between the ruled lines) 1/40 of a second, for ⅛ inch 1/80 of a second, for 1/16 inch 1/160 of a second. Let us assume a race with all six competitors finishing within 1/10 of a second, a finish which no judge could determine. A picture would present itself as illustrated on this paper covering a paper space of one inch from first position to sixth position."

Individual equipment that may be used to increase the swimmer's skill and physical condition is extensive and interesting. The equipment should include flutterboards for kicking practice. These are inexpensive and vary in size. They may be of pine, painted white with beveled edges. A suggested size is fifteen inches in width, one inch thick and from two to three feet in length (Illustrations V and VI). Cans, water-polo balls, rubber bands, waterwings, or almost any buoyant object, are useful and necessary for arm practice. They may be placed under the feet and legs to hold the body in the horizontal plane. Buoys, like the cans (Illustration VII) may also be used to raise the body in the water during butterfly breaststroke arm prac-

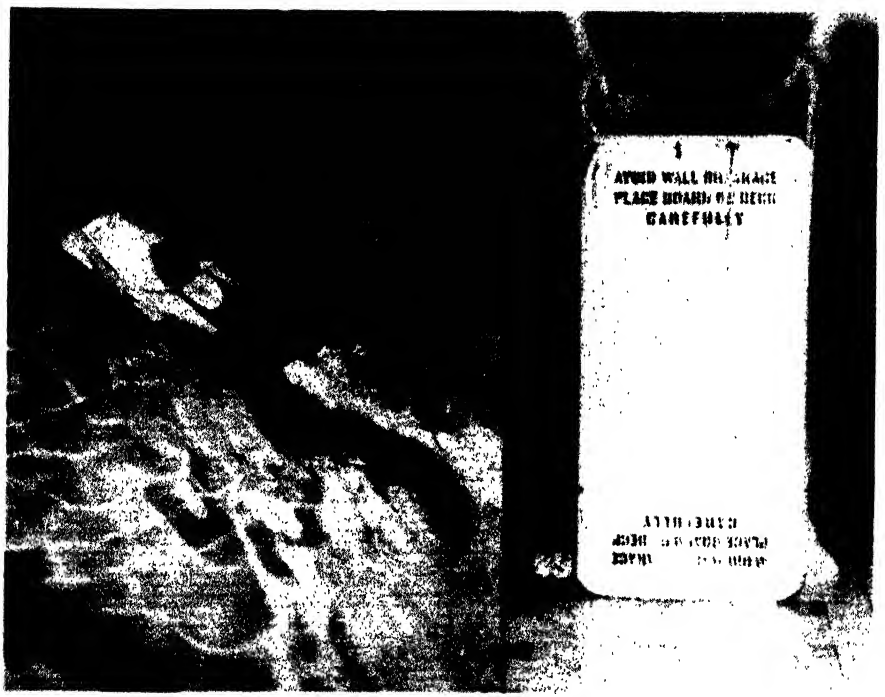


IV. Recording Paper

This paper for the revolving drum comes in white sheets 33" x 3". It is printed with lane lines and ruled with fine lines. Each spacing between ruled lines indicates a time lapse of 1/50 second. Black marks (dots) are made on the white paper by the spark, indicating finishing position. In addition to black mark, each dot has a small hole in the center, where paper has been punctured by spark. This recording shows a race in which all six contestants finished within 1/10 of a second from 1st to 6th. The relative lane positions are clearly indicated over a spread of 1 inch on the recording.

tice. Rubber bands cut from automobile innertubes may be used to immobilize the legs during arm-stroke practice, when buoyancy is not required or desired. This type of arm practice requires more power than where the legs are supported by some buoyant object.

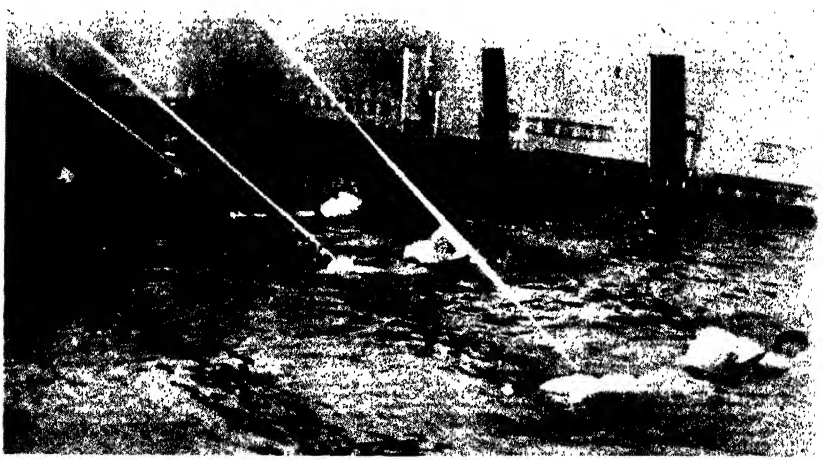
Long rubber bands, onto which are attached wide canvas belts, are of great help in early-season workouts, enabling a coach to give a great number of candidates as much work as desirable. This is especially helpful where space is limited. Swimming in this limited position makes the more buoyant, gliding swimmers, who have an easy run and who may be inclined to loaf, overcome resistance by pulling the rubber band to a fixed point for a fixed time. These rubber bands, with the belts, may be used for arm practice alone (as in Illustration VIII); legs alone (as in Illustration IX); or the stroke as a whole (as in Illustration X).



V. FLUTTERBOARD VI. FLUTTERBOARD

Rubber swimming fins, which have recently come on the market, are also a great aid in developing the kick, especially the whip of the feet. Because of their flexibility and their extensive surface they increase the propulsive power of the legs tremendously and illustrate to the swimmer the great part loose ankle whip and broad surface of the foot play in the leg

VII. Buoy



VIII. Rubber Bands and Belts — Arm Practice

drive. Another advantage of the fins is that the added friction and the greater amount of resistance to be overcome place a heavier load on the legs, thereby increasing the strength of the leg drive. Greater flexibility of the ankles is also developed by the use of these flippers (Illustration XI).

Mirrors (Illustration XII) are also a great aid in enabling the swimmer to check his body position, especially the shoulder level, the proper catch of the arms and a check on any sideslip in the arm pull. Mirrors have this added advantage, for by making the swimmer ride high in watching his arms at work they will further result in the development of the arm depressors.

Submarine windows have been spoken of previously. Lacking such installation, under-water observation is still possible by the means of a diving helmet. Actually, a great deal more can be seen with an under-water helmet, because the observer is free to watch the swimmer from side and front and also from the bottom; as a matter of fact the observer is free to move in any position or any spot. Of course, the great disadvantage is the inability to get under-water movies and pictures with the helmet.

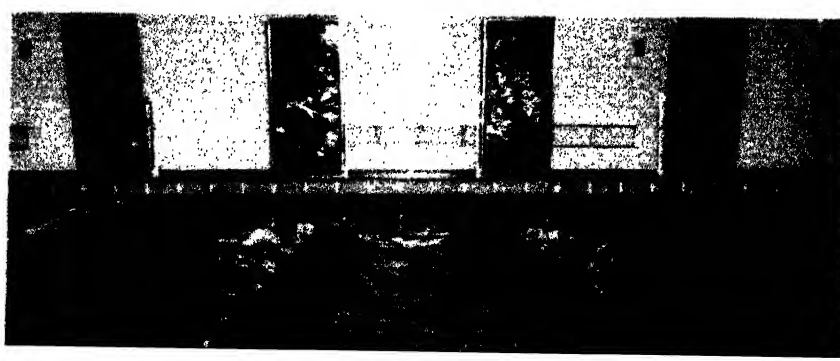
TESTS

Having checked over the pool with a view to bringing it to its highest efficiency from the competitive swimming standpoint, and having assembled all the additional equipment that would be of aid in practice and training, there is left of course the most important factor—the swimmers themselves.

Immediately the question comes to mind as to which physical type makes the best swimmer. Theoretically, all things being equal, any advantage rests with the flexible type. Such an individual has the fullest possible range of motion in joints, especially the ankle, knee and shoulder joints. Loose ankles and loose knees make possible the whippy, undulating kick that has such propulsive power, and the fullest range of motion in the shoulder joint enables the recovery of the arms without distorting the ideal flat-trunk position. Loose knees mean hyper-extension in the knee joint, seen in so many outstanding swimming stars. However, there are so many factors that enter into the make-up of the competitive athlete that one can quote examples of tall men and short men, of slight men and heavy men, so that really the only prerequisite for the competitive swimmer is interest in the activity and a desire to excel. Following are the names of outstanding swimmers, which will indicate that no one type has a corner on swimming excellence:

X. Rubber Bands and Belt — Whole Stroke

XI. Flippers



SWIMMING TYPES

SPRINTING TYPES

Heavy Muscular	*Large*	*Medium*	*Small*
Fick (U.S.)	Weismuller (U.S.)	Wolfe (U.S.)	Arai (Japan)
Walters (U.S.)	Daniels (U.S.)	McGillivray (U.S.)	Yusa (Japan)
Kirar (U.S.)		Toyada (Japan)	Miazaki (Japan)
Thompson (U.S.)		Schwartz (U.S.)	Barker (U.S.)
Kahanamoku (U.S.)			Bronson (U.S.)
			Quayle (U.S.)

MIDDLE-DISTANCE TYPES

Large	*Medium*	*Small*
Medica (U.S.)	Flanagan (U.S.)	Kitamura (Japan)
Charlton (Australia)	Borg (Sweden)	Makino (Japan)
Crabbe (U.S.)	Taris (France)	Terada (Japan)
Ross (U.S.)	Hodgson (Canada)	Uto (Japan)
Gilhula (U.S.)	Macionis (U.S.)	Amano (Japan)
	Cristy (U.S.)	Beaurepaire (Australia)
	Ruddy (U.S.)	Langner (U.S.)
	Kalili (U.S.)	Zorilla (Argentine)
	Haynie (U.S.)	Clapp (U.S.)
		Nakama (U.S.)

BREASTSTROKE TYPES

Large	*Medium*	*Small*
Rademacher (Germany)	Higgins (U.S.)	Koike (Japan)
Moles (U.S.)	Tsuruta (Japan)	Hamuro (Japan)
Schmieler (U.S.)	Ildefonso (Philippines)	Kasley (U.S.)
Kaye (U.S.)	Balke (Germany)	
Sietas (Germany)	Skinner (U.S.)	
Hough (U.S.)		

BACKSTROKE TYPES

Large	*Medium*	*Small*
Chalmers (U.S.)	Lauffer (U.S.)	Kiokawa (Japan)
Kojac (U.S.)	Zehr (U.S.)	Kawatzu (Japan)
Kiefer (U.S.)	Drysdale (U.S.)	Iriye (Japan)
Vande Weghe (U.S.)		

However, to enable the coach to classify his men with a view to placing them in events in which their physical characteristics would be most advantageous and also to discover quickly their strengths and weaknesses, certain tests are in vogue which are of great assistance in pointing the way to the development and training of the swimmer in the early season especially. These tests are also a great motivating factor, especially with the younger competitive swimmer.

After years of experience every coach learns to diagnose the assets and liabilities of a swimming stroke; whether the swimmer has a strong arm pull or a strong leg kick; whether the swimmer has a "run" or "glide," which is a combination of the ability to float and a proper timing of arms and legs. Many such items are very pertinent in a knowledge of speed swimming. The mechanical adaptability of the body would include flexibility, the surface area of the propelling members, the entire body surface area related to resistance, the floating ability of the body and the power of the propelling factors; namely, the pull of the arms and the whip of the legs.

Crude subjective tests have been made for years by coaches for their own individual information. These have included the speed in stroke, using the arms alone with the legs tied; the speed of the stroke using the legs only, the upper body being supported on a buoyant object such as a kicking board; and, of course, the stroke as a whole was then timed. Flexibility of the shoulder joint was tested by a simple arm extension overhead and the flexibility of the ankles tested by simple plantar and dorsal flexion of the foot.

The position of the body in the water and the floating ability could be observed by the ordinary floating tests used in lifesaving, which consisted of lying on the back and floating and of so-called "dead man's" float, lying face down. But it remained for Professor Thomas K. Cureton and his colleagues at Springfield College to formalize this information in a series of objective tests, which enabled coaches and swimmers to obtain interesting and helpful information on the ability and adaptability of the individual swimmer as well as the swimming of types and groups. By these tests accurate information is also made available to the individual swimmer regarding the separate contribution of the many factors involved in the whole stroke. The work of Prof. Cureton and his colleagues is reviewed in the Research Quarterly of May, 1940, and every coach and swimmer is urged to study this comprehensive and helpful work in swimming tests.

In beginning the season it is recommended that certain of the objective tests be given. The more essential of these tests would include the Cureton Velocity Tests, the Flexibility Tests and the tests dealing with Floating

Exercise No. 29 (Ills. 56 and 57). For strengthening of the back, back thigh and lateral trunk muscles, and for stretching of the lateral trunk muscles.

Lying face down with hands back of the neck and legs spread with pressure support on the ankles as in Ill. 56:

Raise chest just off the floor, and slowly bend from side to side as in Ills. 56 and 57. Repeat 20 to 40 times.

Note: The legs must be kept spread by the supporting partner. This gives a firm base from which to work. If the legs are brought together the trunk has a tendency to roll and spoil the effectiveness of the exercise. An effort should be made to bring the elbow as near the hip as possible on the bending.

Exercise No. 30 (Ills. 58 and 59). For strengthening of the long back and lateral trunk muscles and the retractors of the shoulder blades.

Lying on the side with the hands back of the neck and support applied by partner as in Ills. 58 and 59:

Slowly raise trunk sideward and upward and return to starting position. Then execute on the other side, as in Ills. 58 and 59. Repeat 15 to 30 times on each side.

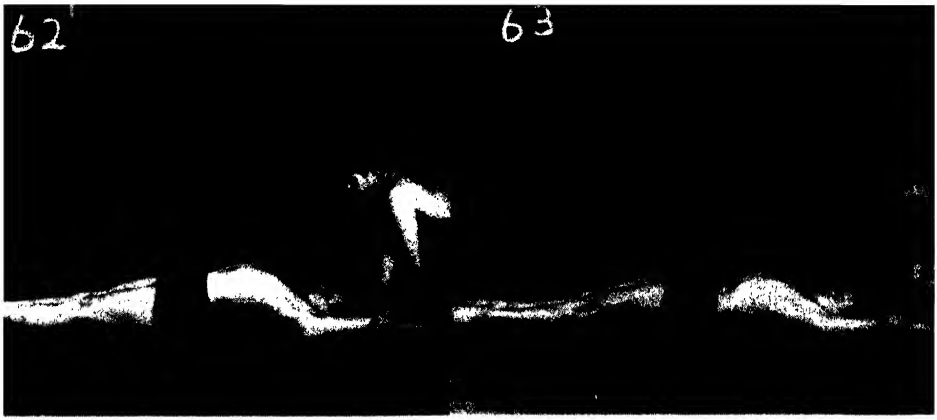
Note: The partner giving support must keep the exerciser directly in the lateral plane with his hands in the position shown in Ills. 58 and 59, and apply enough leverage to keep the trunk from falling back on the buttocks. This tendency to fall back on buttocks brings into play the abdominal muscles rather than the lateral trunk muscles, the use of which is emphasized in this exercise. Both elbows, especially the under one, must be kept well back.

Exercise No. 31 (Ills. 60 and 61). For strengthening the abdominals and lateral trunk muscles and stretching of the chest muscles.

Lying on the back with both legs perpendicular as in Ill. 60 and the hands back of the neck. Firm pressure support is put on the elbows:

Slowly swing the legs from side to side through the perpendicular as in Ills. 60 and 61. Repeat 30 to 50 times.

Note: Great care must be taken to keep the legs controlled. There will be a great tendency not to point the toes; to let the legs spread; to bend the knees and to let the legs fall out of the perpendicular and forward from a right angle position to the floor. Elbows must be held down firmly.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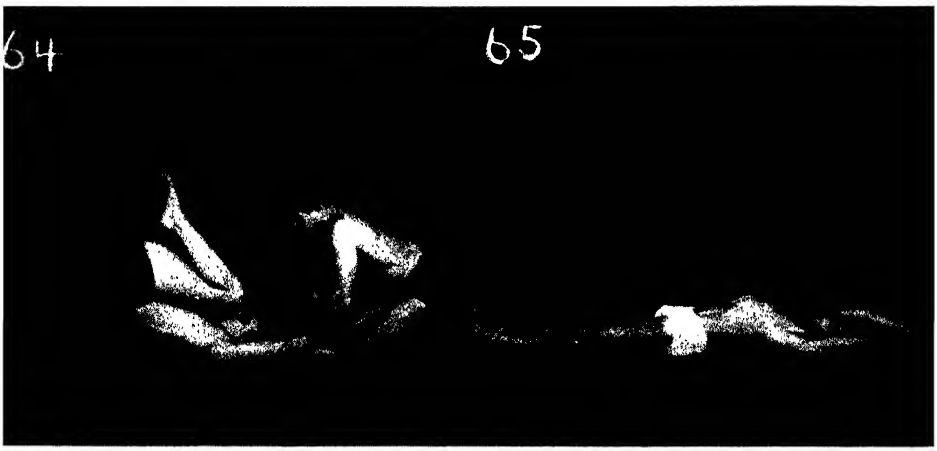
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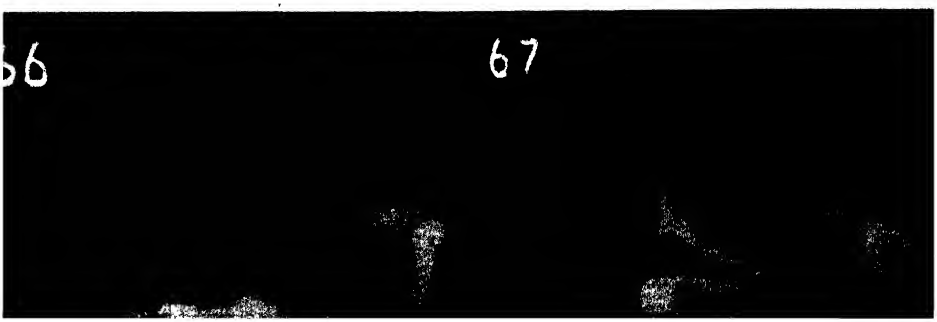
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FOR BACKSTROKE SWIMMING

Exercise No. 41 (Ills. 80, 81 and 82).

Lying on the back on the table, hold the middle handles, arms extended overhead as in Ill. 80:

Pull sideward and downward as in Ills. 81 and 82 and return to starting position as in Ill. 80. Repeat 200 times.

Exercise No. 42 (Ills. 83, 84 and 85).

Lying on the back on the table with the arms extended overhead, hold the middle handles as in Ill. 83:

Pull the arms forward and downward as in Ills. 84 and 85 and return to starting position as in Ill. 83. Repeat 200 times.

Into the Water

STILL BEARING IN mind a six months' program and using the first two months for conditioning exercises out of the water, we're now ready to drop all activity other than that which actually takes place in the pool. The first few days of the water session can be taken up with a recheck of fitness as indicated by the tests that were given at the very opening of the training period, before the prewater conditioning exercises were undertaken. What these tests should show is increased flexibility, increased muscle strength and power, and increased cardiac efficiency. As a matter of fact the tests should show a decided improvement in every checkup, except the velocity tests that are concerned entirely with efficiency in the water.

If the number of the squad permits, all swimmers should be worked at one session, including free-style, breast- and backstroke. If a division is to be made because of the size of the squad and limited space in the pool, then free-style men could be worked in one group, back- and breaststroke men in another. But it can't be emphasized too strongly that the squad should work once a day together for the sake of general spirit and morale.

Early in the season, if time permits, a second daily period devoted to individual correction is definitely advantageous.

BREATHING

It is just as well in the early sessions, always to open up the lesson by a practice breathing period. Before going into the water the squad is reminded that as far as possible all the air should be expelled from the lungs with forced expiration through the nose and mouth. When all the air is out, the swimmer comes to the surface for a quick, deep inhalation, immediately submerging and exhaling so that in the entire cycle a strong expiration and inhalation is taking place. The swimmer should try to avoid any shallow land breathing. To try this and check it in the water, divide the squad into two groups, one group working at a time. First have them try breathing in a vertical position, holding on to the gutters, and then bobbing up and down getting a deep breath above water then dropping below the surface just deep enough to cover the head and force the expiration. The correct

execution of this breathing enables the swimmer to bob up and down easily in rhythm, with the greatest part of the time consumed in expiration under water at a ratio of about five to one. The coach should walk up and down, checking and seeing whether each swimmer is doing it in rhythm. In most cases where it is not being done properly it is due to the fact that the expiration is being delayed. This can be noted by a lack of bubbles that accompany forced exhalation. This breathing should be practiced so the swimmer can do it 50 to 100 times in rhythm.

After this has been mastered it should be tried with the body in the horizontal plane, top hand grasping the gutter, lower hand placed a foot and a half or two below the gutter on the supporting wall to hold the body out in a horizontal plane. Now the body position is more like that used in swimming and the same breathing practice should be indulged in, keeping the trunk flat, exhaling with the face down and getting the head in the side position to facilitate the breathing by twisting the neck, rather than lifting the head or dropping the opposite shoulder. After breathing in this position is mastered, the free stylers should add their up-and-down kicking action and the breathing should be practiced in the ratio, one breath to every six leg beats. No matter how skilled the swimmers become in the breathing, it is a good thing to open every lesson with this breathing practice. This should be done with the breaststroke and backstroke swimmers as well.

STARTS

As the first part of the season is going to be devoted to fundamentals, let us begin with the essentials of starts, turns, body position, breathing, and stroke.

We will start at the very beginning, with the motion that takes the swimmer into the water, namely the start. In a crouched position, arms hanging easily, the swimmer steps to the mark and gets a firm grip on the edge of the starting platform, with his toes curling over the edge. The knees are partially bent, the body weight well forward, head up, and the eyes fixed on the far end of the pool. In competitive swimming, when the men have been called for the races and all have approached the mark, the swimmer should get into a "semicrouch" back of the mark so that he won't have to use too much time taking the final position when the starter puts them on the mark. If no preparation has been made for the final position, the contestant is very often placed at a disadvantage by taking too long getting into position and the gun may be fired before he has actually gathered himself fully for his final drive.

XIII. *From left to right:* A.—This is a good dive. Abdomen well retracted; back flat; arms well extended. Only fault is the low position of the head. B.—Body in good position. Arms well extended; head a little low; lower back arched a little too much. C.—Body position poor. Arms only partially extended, with a failure to take full advantage of the arm weight. The jump is too high rather than out. The legs are late driving and will hit the water with a great deal of resistance.

XIV. *From left to right:* A.—Body in good position. Arms extended; head a little too high; abdomen retracted; lower back flat; legs in line with trunk and toes pointed. B.—Poor body position! Poor dive! Arms in poor position, with failure to take advantage of a fully extended arm throw. Dive too high. Lower back arched and abdomen sagging. The dive will be a flop, with much resistance. C.—Arms, head and trunk in good position, but legs driving late cause a "jack" at the hips.

Naturally the starter is going to give the contestants every opportunity, but he hasn't any way of checking that final, definite, easy and correct position that is peculiar to each individual. Being on the mark ready for the start, every energy and thought should be directed by the swimmer to the actual technique involved in his start, rather than to the sound of the pistol or the starting command. When the pistol shot comes he should drive hard with his legs, swing the arms forward vigorously, get out as far as possible and yet enter the water with his body streamlined. There should be a straight line from the tips of the fingers right straight through the body to the toes. This means his arms are fully extended overhead without the elbows being bent and are held in close to the head because any spreading would increase resistance on the inside surface of the arms. The head which is kept up in order to get as much distance as possible in the air is dropped before the swimmer enters the water. The back is straight, being neither arched nor flexed.

This latter position would make for a break at the hips, or a "jacked" position, causing friction by the thighs hitting the water. The legs, having driven hard off the box, are in straight line with the rest of the body and the toes are pointed, bringing the instep into as straight a line as possible with the shinbone. In achieving this streamlined body position there must be the least possible time taken in getting off the mark, and every effort must be made to get the greatest amount of speed and drive off the box, in order to get as much distance as possible on the dive and in the shortest time. Because the dive carries such weight in the sprint it is most important to become proficient in this phase of the race.

The swimmer must remember that the arms must be thrown out and forward vigorously because of the advantage of the arm weight involved. He must remember to keep his head up to gain distance but not for too long. If he stays in the air too long there will be a flat drop on the water, with a loss of momentum. The action of the arms and the legs must be coordinated. If the drive from the legs starts too late there will be a tendency to break or jack at the hips with the resultant flop of the legs against the water, causing added friction. On the other hand, if the legs drive before the arms are extended far enough, the body position will be arched and the swimmer will land on his abdomen which will break his speed. (See Ills. XIII, XIV, and XV, page 64, for faults in the racing dive.)

The correct body position off the starting box (arms fully extended, lower back flat, abdomen well retracted, legs in line with trunk and toes pointed) should be kept until the body is well under water. After getting well under water the legs should start their up and down drive and the

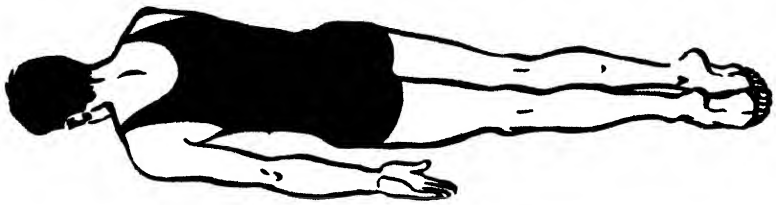
approach to the surface started. This is done by a gradual raising of the head and the arms. Just before breaking the surface the first arm should start its pull so that this arm stroke is completed just as the body breaks the surface. The timing of this first arm stroke is important. If it starts too soon, thereby reaching a position of recovery before the body breaks the surface, this bent arm in recovery will drag a lot of water, causing great friction. On the other hand, if the first arm stroke is delayed and doesn't begin its pull until after the surface has been reached, it means delay in starting the arm stroke with a loss of momentum and speed.

The choice of the most advantageous distance from the starting box at which the swimmer should come to the surface, will have to be determined by the stop-watch. The fullest possible advantage should be taken of the dive because it saves energy. On the other hand there should be no sacrifice of speed by staying down too long. The point at which the speed of the swimmer on the surface is the same as the speed of the swimmer under water in the glide should determine the point at which swimming should start.

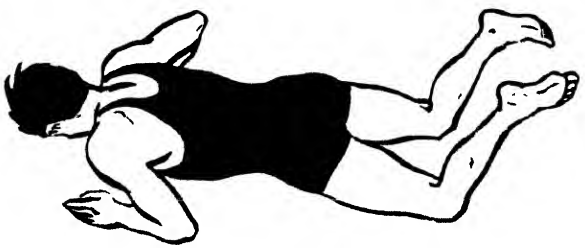
On coming to the surface there should be no breathing on the first few strokes, as the swimmer should get fully into his stroke without any possible body distortion which might follow rolling for a breath.

In addition to the action and movement just outlined for the start, other means and exercises that may be used to increase the strength and skill of this starting movement can be enumerated as follows:

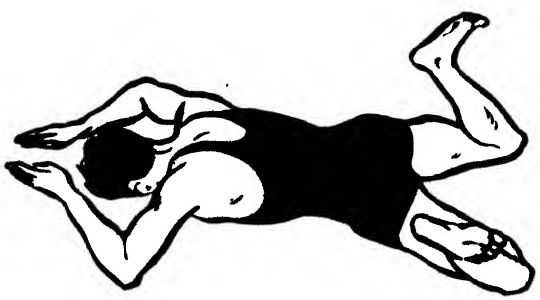
In order to get distance on the dive the swimmers can take jumps, as in a standing broad jump, for the sake of utilizing the arm throw as well as getting the leg drive. Then in racing-dive practice the swimmer may reach for some object like a pole or rope placed almost within touching distance of his hands, in order to get a vigorous and full extension of the arms. To get a clear picture of the leg drive the dive may be executed without the arms, which are held firmly at the sides. Following this practice in the driving of the legs and the swinging of the arms in order to get distance, the next step would be practice in streamlining. This can be done by having the swimmer execute a plunge from the racing start with no movement of the arms or legs in the water and a graceful glide to the surface. In sequence the crawl kick may be added to these plunging starts, ending up in the full and correct racing start.



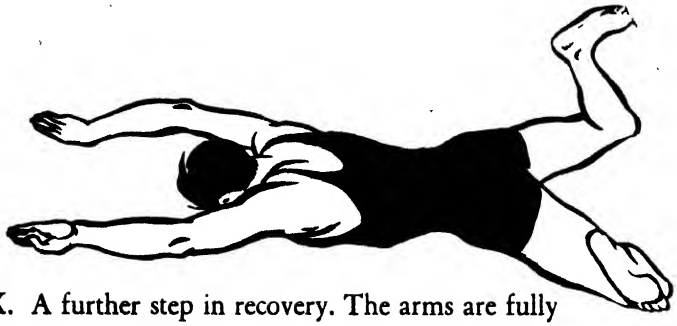
XVI. The illustration shows the position of the body at the finish of the glide with the arms having whipped downward and backward, finishing at the thighs, and the legs together with toes pointed.



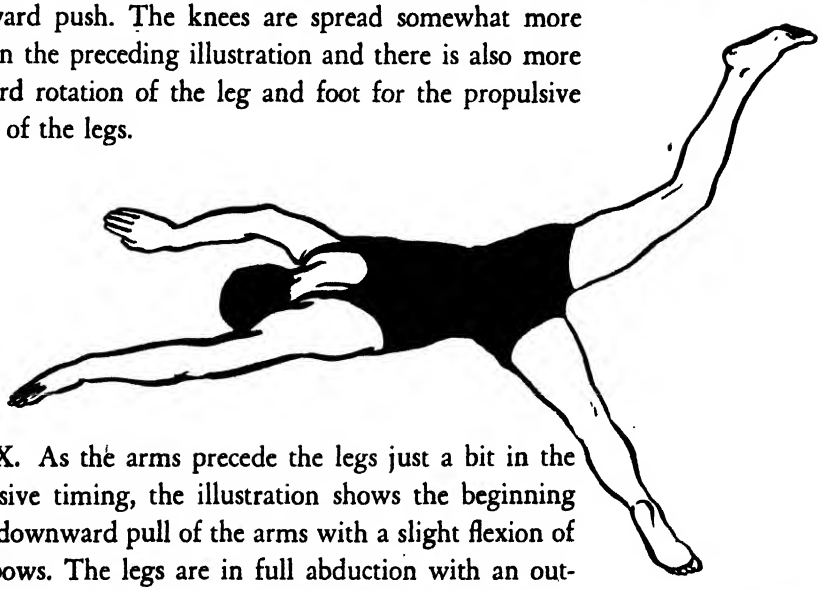
XVII. Beginning of the recovery. The elbows are flexed and the arms move in close to the body. In the leg recovery the knees are separated and bend with the lower leg in line with the thigh and the feet in line with the leg, or somewhat inverted.



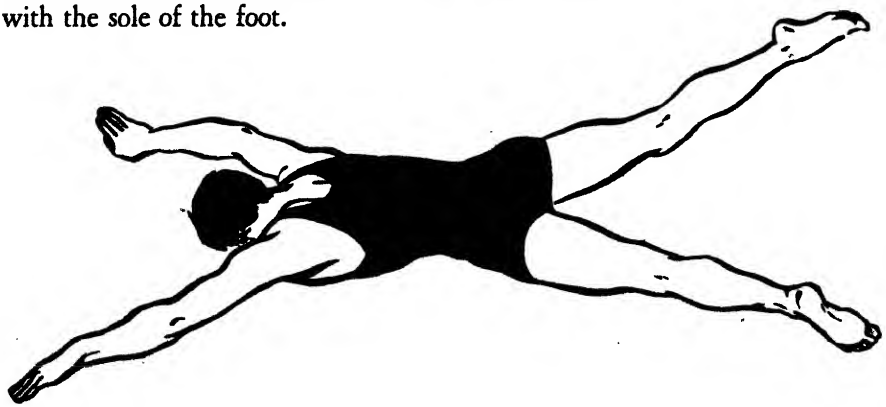
XVIII. The arms are further extended in recovery. In the recovery of the legs the knees are almost fully flexed. The knees are opened with a wider spread with the lower leg still in line with the thigh but the feet are beginning to rotate outward in preparation for the propulsive action.



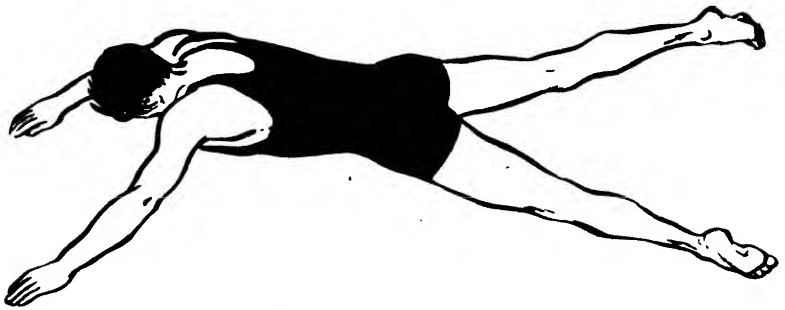
XIX. A further step in recovery. The arms are fully extended and are ready for the downward pull and backward push. The knees are spread somewhat more than in the preceding illustration and there is also more outward rotation of the leg and foot for the propulsive action of the legs.



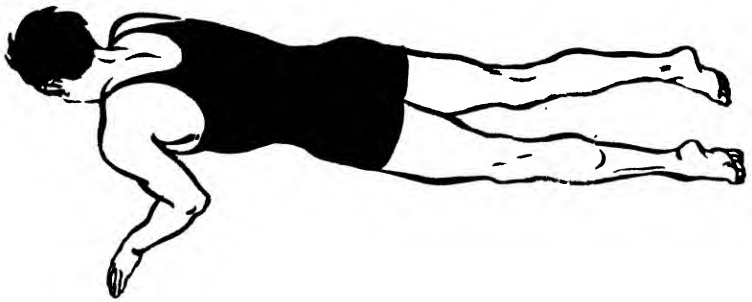
XX. As the arms precede the legs just a bit in the propulsive timing, the illustration shows the beginning of the downward pull of the arms with a slight flexion of the elbows. The legs are in full abduction with an outward rotation so that the water may be thrust backward with the sole of the foot.



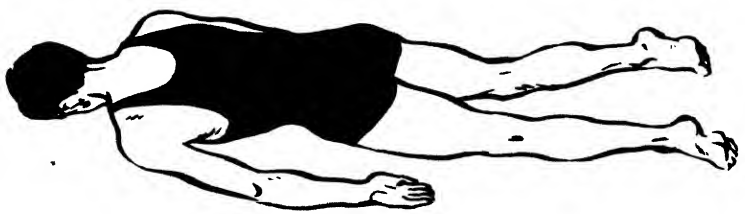
XXI. A further step in propulsion with the arms pulling downward and the legs pushing the water backward.



XXII. A further advance of the arms and the legs.



XXIII. The arms are now halfway through their pull, the illustration showing considerable flexion of the elbows in preparation of the backward push of the water with the forearm and hand.



XXIV. The finish of the stroke.

Note: The illustrations do not clearly show the marked circumduction of the foot at the ankle and of the leg at the knee from the position of full recovery, as in Illustration XVIII, to the fully extended leg position, as shown in Illustration XXI. This marked screwing motion or circumduction of the knee and ankle are greatly responsible for the powerful propulsive action of the breaststroke.

START IN BREASTSTROKE

The breaststroke start in its mechanics is the same as in the free style until the entry into the water. On entry the dive is deeper and longer, because the momentum gained in the dive from the starting platform, combined with the lift and the forward propulsion of the body due to water pressure (if the body is planed in the correct position), results in speed greater than that which can be developed by the breast stroker swimming on the surface.

This under-water swimming is utilized by a great many swimmers with decided success, especially following the dive and the push-off after turns. As a matter of fact, before the development of the butterfly breaststroke a great many breaststroke swimmers in the 100-yard race were under water more than they were on the surface. The dive from the starting platform should carry the swimmer to a much lower point under water than in the free style, and of course the depth to be taken in the dive will depend upon the distance the swimmer wishes to stay under water. The greater the distance the swimmer wishes to cover under water, the deeper the dive must be, because after the lowest point is reached the rise must be made with a body angle at which the head is slightly higher than the feet. This position in the rise of the body to the surface causes the least friction and gives the greatest forward momentum.

The stroke under water is described in the accompanying illustrations. Here again the point at which the swimmer should come to the surface can be determined by the stop-watch. However with the advent of the "butterfly" the number of under-water strokes following the start has been decreased due to the increased speed of the new style.

In the timing of the stroke under water the arms and legs are recovered simultaneously, and the propulsive backward thrust and whip of the legs is executed at the same time as the sideward, downward and backward pull of the arms. The arms are pulled through to the thighs with a whipping, sculling motion of the hands at the end of the arm stroke. The pull of the arms is also more downward and backward than sideward. (See illustrations XVI-XXIV of under-water breaststroke.)

START IN BACKSTROKE

The backstroke start is made in the water; the swimmer grasps the bar or grips, which are set into the starting end, and presses his feet on the wall so that he is in a crouch or squat position. At the signal the swimmer

throws his arms vigorously overhead as hard and as far as possible, having the spine actually straight or somewhat extended. There must be no flexion of the spine or hump of the back, with the arms well overhead, hands together, elbows straight and arms in close to the ears as in the free style.

After the body is well under water, the legs start to drive and, as in the

XXV. Backstroke Start

From left to right: A.—Good body position. B.—Good body position. Insufficient arm extension. C.—Week push-off. Body position too high. Poor arm action. D.—Good body position; possibly a little too high.

free style, the raising of the head and the arms toward the surface will bring the body up into stroking position. Again, as in free style, the first arm completes its pull just as the body breaks the surface and the swimmer then proceeds into an alternate overarm on the back. This alternate stroke at the start is the most acceptable one, even though some swimmers still use the double down arm pull on the first stroke. (See Ill. XXV.)

FREE-STYLE STROKE

The development of free-style swimming has been touched upon in the introductory chapter. The last ten years have seen several modifications of what the writer considers the ideal American stroke as exemplified by Weismuller, and back in favor at the present time in the swimming of the outstanding swimmers of the moment. Weismuller's style was a fairly high body position with a vigorous catch of the arms, with no slide on the catch.

In recent years there has been a great deal of discussion about the Japanese free-style stroke, which is an adaptation of the Weismuller stroke and the Arne Borg stroke, which the Japanese swimming authorities thought best suited the Japanese. Borg swam a bit higher than Weismuller and used a shorter, faster arm stroke, and the Japanese stroke, in some respects, falls

somewhere between the strokes of these two great international stars. The Japanese upper-body position is fairly high, legs fairly low in the water, and the knees in the leg drive are bent more than in the Weismuller stroke.

The style of the Japanese arm stroke is short, the theory being that the most efficient range in the arc of the arm pull is the middle half of the 180-degrees arc from the full reach overhead to the full finish at thighs. Therefore, they seek to get to a point 45 degrees short of the full reach as quickly as possible and to recover after a 90-degree pull, or 45 degrees short of the complete pull through. However, with the time taken to reach these established points the catch is made ahead and the recovery beyond. This timing accounts for the much more rapid stroke of the Japanese, which is possible for swimmers with such short arms and legs.

At the time that the Japanese were working on their shorter, quicker stroke, a style came into vogue in the United States that was the other extreme. These U. S. swimmers were very flat in the water, well up on the surface, and the arm action was a full extension, pulling through so that there was arm action through almost the complete arc of 180 degrees. The style has again swung back to a point between the Japanese stroke and the stretched out American stroke. The writer, because of lack of a better way to describe this, would like to term it the "Weismuller" stroke, or the stroke he feels, subjectively of course, to be the most efficient free-style stroke.

The body should lie in a perfectly flat position with the head and chest fairly high, the water level just above the eyes; shoulders level with the surface of the water, and the horizontal axis through the shoulders should be at right angles to the long axis of the body. This means, ideally, that there should be no dipping of the shoulders or rolling of the body; neither should there be lunging nor hunching of one shoulder ahead of the other. The arms should move in the shoulder joint, but the shoulder itself should be in a fixed position, the body moving over the arms, literally "crawling."

In the alternate arm action there should be decided pressure on the water at all times, with one arm or the other. Most of the propulsive power comes from the arm stroke and it is, therefore, highly important that the arm stroke should be as nearly perfect as possible. The action of the arm stroke is to catch, to press, to pull and to push. As the hand comes forward for the catch, it should be in line with the forearm and the elbow should be higher than the hand and the wrist. The catch is forward in line with the shoulder, and the arm is extended as far as a high elbow and wrist will permit. This does not mean an exaggerated lifting of the elbow, but the elbow should be flexed enough to give a strong "set" to the arm so that,

when the catch is made, strong pressure can be immediately exerted on the water. This means there can be no stretching or over reaching with the arm.

On catching, the hand immediately engages the water in a downward and backward press, with the elbow slightly flexed. The direction of the arm pull is slightly toward the middle line of the body and after passing the vertical there is a push straight through at the end of the stroke out past the thigh. There is no gliding of the arm on the catch and a full stroke of the arm is taken with no attempt to finish short. The maximum amount of water must be engaged by the hand and the forearm throughout the stroke with as little side slip of the arm as possible. The broadest aspect of the hand and the forearm should engage the water at all times. A working phrase of press, pull, push, indicates the necessity of such action.

Care must be taken not to allow the catch and pull to be too wide because such a position cannot take advantage of the strong muscle pull that is possible with the arm nearer the middle line of the body. On the other hand a pull across the middle line of the body under water is incorrect because in this position a great deal of water must be slipped in recovery since the arm has to be moved outward and in such action the backward push of the water at the end of the stroke is lost.

The angle of the hand and forearm at the top of the stroke is in a different position than at the end of the stroke in order to get the greatest possible backward push of the water. In the first half of the arm stroke the wrist and the elbow are high and flexed to engage as much water as possible, but at the end of the stroke the wrist is extended so that the hand and forearm are in a better position to get a backward push of the water.

On recovery the elbow is flexed and the hand is moved outward and inward in a semicircular motion until it reaches a position close to the ear; and then is extended forward to catch the water and to press, pull and push again. The pull-through of the arm from catch to finish is fairly straight with only a slight direction inward. Any lateral movement inward or outward cuts down the efficiency of the backward push of the water, which is the power that drives the body forward. (See Illustrations XXVI, XXVII.)

The leg-drive in the crawl stroke is an alternate rhythmic up-and-down drive of the legs. This undulating up-and-down action of the legs and feet pushes the water backward with the resultant forward movement of the body. The tempo used by most swimmers at the present time is a 6-beat crawl, in which there are 6 up-and-down beats of the legs to a full cycle of the right and left arms.

Although the greatest part of the propulsion in the crawl comes from the arms, the most interesting development in the modern crawl has resulted

XXVI. Arm Catch

XXVII. Arm Catch

from advances in the efficiency of the leg drive. It is difficult to say which part of the legs' action contributes most to the propulsion, the down-beat or the up-beat, and until this is determined scientifically it will remain a moot question.

However, it would seem that where the head and chest are high in the water, with the resultant deep-knee push, more propulsion comes from the down-beat than from the up-beat. In a position where the body is flat with a long arm reach and the leg drive much nearer the surface, the propulsion derived from the legs is fairly even in the down-beat and the up-beat. The action of the legs is a very loose, whipping, undulating motion, with the power coming from the muscles of the hip joint, whipping out through the knee and the ankle. The more strength and whip to the kick as the result of loose ankles and feet, the more powerful the kick.

Recently there has been a very vivid demonstration of the propulsive power of the loose ankle and foot in the rubber boot or shoe illustrated in Chapter II. This boot, which enlarges the surface of the foot and the flexibility of the ankle, greatly increases the power of the kick.

BACKSTROKE

Having checked the start, the coach is now ready to check the swimming stroke on the back. Until fairly recently the catch of the arm in the backstroke was the same as the catch in the free style, that is, directly overhead in line with the shoulder. The style in vogue at the present, however, is a catch about 15 degrees short of full-arm extension overhead, which would bring it a little to the side. When there is enough flexibility in the shoulder to permit it, the forearm may be rotated outward to a position where the catch is made with the palm of the hand down on the water. This is quite an aid in the initial press and in keeping the upper body in a more efficient riding position.

However, as soon as the catch is made the arm is rotated inward so that the hand is at right angles to the surface of the water, enabling the hand and especially the forearm to press backward. The arm sweep is comfortably under water so there is no possibility of breaking the surface in a "washout" and pulls at this depth all the way through the stroke. From the side horizontal or middle position of the arm stroke, to the finish of the hand at the thigh, the angle of the forearm and the hand should again be changed so that there is the greatest possible backward push of water. This means that at the beginning of the arm stroke, the arm and hand can be somewhat

slightly hooked and at the end of the stroke the angle changes so that the hand is in the position of extension.

Here again, in alternate rhythm, just before one arm finishes its stroke the other arm is ready for the catch so that there is a continuous arm pull. In recent years the recovery of the arm has changed. Formerly the style was a rotation of the forearm inward with the thumb side down on recovery and then a quick, full flexion of the elbow with the elbow leading in recovery. Then when the upper arm reached an overhead position the elbow was extended to enable the forearm to catch again.

At the present time the arm is recovered fairly straight with only a slight flexion of the elbow and there is no attempt at inward rotation of the forearm, so as to get a high recovery elbow.

The alternate leg whip in back stroke is in the same tempo as the free-style, most swimmers using the six beats of the legs to the full cycle of the arms. However, in the backstroke, most of the propulsion seems to come from the up-whip of the leg. Here, again, the legs undulate; in other words, before there is a full extension of the knee and ankle on either the up- or down-beat, the recovery action takes place which gives the whipping effect of the legs, so the up-and-down motion of the legs is a flowing motion rather than a precise and full up-beat and then a full down-beat. One might express it as a rhythmic, undulating, following motion.

The position of the body in the water should eliminate as much friction as possible, and high or low head position must be determined by the balance of each individual in the water. For instance, with some swimmers the head must not be too high, which position may give rise to a flexed spine or a rounding of the back that may cause friction. Yet with others there may have to be a little break at the hips in order to keep the legs fairly deep. If the head and spine are extended with the back arched, the tendency may be for the legs to come too high out of the water, thereby losing traction in the leg drive.

BREASTSTROKE

Now we come to a stroke that has probably undergone more experimentation and change than any of the racing strokes within the last ten years. This is, undoubtedly, due in part to the great increase in speed in the other strokes, so that the people interested in this event set themselves to take it out of its traditional and highly stylized form and mold it into something productive of greater speed

This has been especially true in the United States and Europe. As

yet the Japanese have done little with breaststroke experimentation. Two experiments in the breaststroke have taken place, namely the under-water swimming and the so-called "butterfly" breast stroke. Even though these newer styles have increased the efficiency and speed of breaststroke swimming, and even though the butterfly stroke has superseded all the other styles over the shorter racing distances, nevertheless, the conventional breaststroke is still the foundation stroke and few breaststroke swimmers have entered top-flight circles, especially at the Olympic distance, who haven't been good convention-style breaststroke swimmers.

CONVENTIONAL BREASTSTROKE

In the conventional breaststroke, the propulsive power of arms and legs is so distributed that the arms pull at one time while the legs drive at another. A great deal of the skill in the breaststroke depends upon the coordination of this timing so that the maximum of propulsion is attained with a minimum of friction. The result of such timing is evidenced in a glide or run of the body. Characteristic of the stroke of course is the simultaneous action of arms which is also true of the leg action, in contrast to free style swimming and back crawl, where the action of arms and also legs is alternate.

In the gliding position the entire body lies in the horizontal plane with the hands on the surface of the water and together, elbows fully extended, abdomen well retracted, knees stretched, toes pointed, and the heels and buttocks out of the water. This high position in the water offers less resistance than a sagging body position.

Faults to be avoided:

1) In the gliding position do not spread the hands nor bend the elbows, nor drop the arms below the surface of the water.

2) Relaxed and sagging abdomen and an arched back with the resultant low position of the legs, especially of the heels.

The stroke starts with the pull of the arms, downward, sideward, and backward. The elbows remain well flexed until the arms reach a position at almost right angles to the body. From here they are recovered up under the body. The elbows move in close with a movement as though to hold the water in the arm pits. This action brings the arms into a position affording the least amount of friction on recovery and they are then fully extended as described in the glide position.

The kick may be roughly classified as either a whip or a thrust kick,

although there are many gradations and combinations of both. In all breaststroke kicks the action of the legs is simultaneous. The recovery is effected by drawing up the legs with the heels fairly close together and with the knees flexed, with either a narrow or a wide opening sideward. From this position the legs may be thrust backward and together or they may whip from the knee outward and together. The thrust kick is principally used by long legged swimmers and the whip kick by swimmers of medium or short stature. In both kicks there should be as much rotation or sculling action of the foot as possible, but the knee action is greater in the whip kick as the leg describes a circular motion. (See pages 67, 68, 69.)

The illustrations of under-water breaststroke should be studied to note the leg action especially of knee and of ankle.

The movement of the arms and legs should be so timed that the latter are executing their recovery while the arms are in propulsion and the legs execute their propulsive action during the recovery of the arms. The movements of arms and legs in propulsion must be vigorous and those of recovery slow and easy and with as little resistance as possible.

The breath is taken as the arms are in the act of propulsion and the head is immediately dropped at the beginning of the glide as the legs drive. Dropping of the head after the glide is started results in a bobbing or rocking-horse motion which makes the stroke jerky and results in increased friction.

Since competitive breaststroke swimming is an event measured by both time and form a great deal more concern and dispute have been directed at this style than in any other style of swimming. There is still considerable misunderstanding concerning the form of the legs especially with respect to the plane in which the legs move. This is the result of an old rule which prohibited a dropped knee or foot. The chief concern of the coach or official should be with the simultaneous action of arms and legs, and with the body position. The shoulders must be in a plane parallel with the surface of the water and must be at right angles to the line of forward progress. In the leg action there can be no propulsive action using the top of either one or both feet.

The under-water breaststroke has been dealt with in connection with the breaststroke start, so we pass on to the most sensational development in swimming in recent years, the butterfly breaststroke. This stroke meets the requirements of the breaststroke rules at every point. The changed action of the stroke that has added such great speed, especially over the shorter distances, has been the recovery of the arms out of water and the

downward and backward pull of the arms through a greater arc than in the conventional stroke.

Because of some differences of opinion on the beginnings of the "butterfly," the writer thought it might be of interest to get as accurately as possible some of the facts of the development of the stroke. As the development of the stroke was largely the result of the efforts of the Dragon Swimming Club of Brooklyn the writer corresponded with members of this organization and the more pertinent letters received are here included. First from Jack Mellon the coach manager.

Sept. 17, 1940

Dear Mr. Kiphuth:

I have been waiting to speak to Henry Myers before answering your letter as I felt that he could provide me with a little more information than I already had at hand. I honestly believe there can be no questioning of the fact that Myers was the first to practice and develop the new breaststroke sufficiently well enough to use it in meets at distances of from 50 to 100 yards. I personally remember how he first toyed with the idea of the stroke here at the St. George Hotel. This was sometime in 1933, and in December of that year he used the stroke at an A.A.U. meet at the Brooklyn Central Y.M.C.A. Myers tells me that he sent you the whole story at your request several years ago.

Myers later interested Lester Kaplan and Paul Friesel in trying the new stroke, and during 1934 both of the above used it in a number of meets. In January, 1934, Kaplan and Friesel tried for a world's record for 100 yards at City College Pool. Kaplan did 1:07.4, and Friesel was a little slower. The listed record at the time being 1:06.8. Kaplan's best time for the 100 before using this stroke had been around 1:10, and Friesel's, around 1:12. Friesel, during the Summer of 1934, broke the American long course 100-meter record at Manhattan Beach, doing 1:18.2. The following Summer, he broke his own record at the same distance, doing 1:15.5 at Jones Beach, which record I believe is still in the book.

This is about all I can dig up on the subject, but perhaps the boys can give you some more particulars. Their addresses are:

Henry Myers	Lester Kaplan	Paul Friesel
2805 East 27th St.	3715 Kings Highway	264 Avenue O
Brooklyn, N. Y.	Brooklyn, N. Y.	Brooklyn, N. Y.

I hope the above will be of some help and I am sure you will be perfectly accurate in your book if you give first credit to Myers for the development of this stroke.

Yours very truly,

JACK MELLON.

From Henry Myers. Oct. 13, 1940

Dear Mr. Kiphuth:

I have received your letter and am very glad to hear from you. Everything in the letter that Mr. Mellon sent to you is true to the best of my knowledge.

I did invent the "butterfly" stroke and was the first one to use it in an A.A.U. meet. There are plenty of details concerning the first introduction of the stroke into swimming competition which may or may not interest you. Those first races in which it was used are as clear in my memory as though they happened only yesterday. Probably much of this information will be superfluous for your immediate purpose, but inasmuch as you have written me for details, here is the whole story from my own viewpoint. You may use any information out of it that you want for your book.

It was in the summer of 1933, while swimming in Sheepshead Bay, that I first conceived the idea of the over-water recovery breaststroke. After practicing it in the Bay and in the St. George Hotel pool, the extra speed caused by the elimination of the under-water recovery became evident. Having always been a free-style swimmer, it was a lot of fun for me to beat the regular breaststroke swimmers with the odd-looking new stroke in short practice races. Careful perusal of the rule books led to the idea that the new stroke did not violate the A.A.U. rules for breaststroke, as they were then written. With the encouragement of Mr. W. W. Robertson, who was at that time the coach of the Dragon Club, it was decided to try the stroke in an A.A.U. meet in order to find out if the officials would disqualify it.

The race in which the butterfly stroke first saw the light of day was a 150-yard medley event of a meet held at the Brooklyn Central Y.M.C.A., sometime around December, 1933. I was placed in the first heat with Wallace Spence, who was then the National Medley Champion. The spectators all expected Spence to run away with the race with ease.

At the beginning of the race, Spence got off to a fast start and took the lead. Returning to the surface from the starting dive, I began to use the butterfly. Halfway down the 25-yard tank, I caught up to Spence, quickly passed him and kept pulling away. Spence was astonished and thought that I was swimming free style! By this time, the crowd was on its feet, shouting and laughing at the unexpected turn of events. The end of the breaststroke leg of the heat found Spence a full ten feet behind, but he of course overtook and passed me before the end of the medley. The perplexed officials then went into a football-type huddle to decide what to do about the case. Mr. Robertson was

there also with the rule books. The announcer finally stated the results of the heat without any mention of a disqualification, and so was laid down the first precedent concerning the butterfly breaststroke.

Of course I used the butterfly in the final, with results very much like those of the first heat. Spence had scratched out of the final. The order of the finish was: 1—William Giesen, 2—John Wicklun, 3—Myers.

The attitude of the breaststroke swimmers toward the new stroke at that stage of the game is well illustrated by Wallace Spence's statement which was made after the race. He advised me to learn how to swim breaststroke before swimming any more medleys. It was not very long after this that Spence, himself, was using the butterfly in all of his medleys.

A few days later a vitriolic article, entitled "The Spirit or the Letter of the Rules," appeared in the Central Y.M.C.A. magazine. The article was an account of the medley with disparaging comments upon the sportsmanship of "young Myers, who observed the letter but not the spirit of the breaststroke rules." This article, I sent to you, Mr. Kiphuth, after having visited you at Yale several years ago. Perhaps you can locate it in your files.

The next A.A.U. meet in which the new stroke was used was one held at the R.C.A. pool in Harrison, N.J., on March 2. 1934. The event was a novice, 100-yard breaststroke. We told the Jersey officials before the race that we were going to use a new type of breaststroke which had been approved by New York officials and which was in use in New York swim meets and also that what was good enough for New York should be good enough for New Jersey. The officials were not sure enough of themselves to start a controversy with the New York officials, so they agreed readily enough not to disqualify the stroke. Consequently both Kenneth Stevenson and myself used the butterfly that night. The order of the finish was: 1—Stevenson, 2—George Muntz, 3—Myers.

With these precedents set in two states and the speed of the stroke having been demonstrated so spectacularly, the metropolitan breaststroke swimmers began to use it. Friesel and Kaplan quickly became the outstanding exponents of the new style, as Mr. Mellon has stated. You probably have the best information by your own observations concerning the spreading of the stroke through school and college competition.

As the popularity of the stroke grew, the ridiculing stopped and other swimmers began to claim to be the originators. Coach Ed Kennedy of Columbia will certify that I was the originator of the butterfly, if you should wish to get another check on this controversial subject.

Looking back over the history of the stroke it is important, in my opinion, because it has revived a dying stroke. The breaststroke was

losing popularity as a racing stroke because of its lack of speed as compared to the backstroke and free style. It was uninteresting to watch a breaststroke race. In time, the old breaststroke would have become as passé as the side stroke, as far as racing is concerned. The butterfly stroke has changed the picture completely. A butterfly breaststroke race is a very exciting race to watch. The splashing and violent arm motion seem to be quite conducive to spectator enthusiasm.

Hoping that you will be able to pick some useful information out of this long, rambling letter, and wishing you the best success with your swimming book, I am,

Sincerely yours,

HENRY MYERS

BUTTERFLY BREASTSTROKE

In the butterfly stroke all the action of the conventional breaststroke is observed with respect to body position and simultaneous action of arms and legs. The difference lies in the out of water recovery and a pull through of the arms beyond the point used in conventional breaststroke. In the racing butterfly breaststroke there is little or no glide and the kick is much shorter. The timing of arms and legs is also different. In the conventional breaststroke the propulsion of the legs kicks the body into a glide, wherein the arms are resting and extended overhead. In the butterfly sprint stroke, the leg propulsion comes as the arms are at the top of their pull. However, some swimmers have used the conventional breaststroke timing in butterfly swimming with some racing success and nearly all butterfly swimmers use the conventional timing or "half-time" in their practice work.

As the arms must be lifted out of the water in recovery a flat body position in the horizontal plane becomes difficult. Every effort should therefore be made to throw the head forward and down as the arms swing to catch. Another aid to prevent a "slip-back" on recovery of the arms is to draw in the abdomen as the head and arms thrust forward. The hips are thereby kept as high as possible. The pull of the arms may be in line with the shoulders as in free-style or somewhat wider depending on the physical make-up of the swimmer. To facilitate recovery the arms may be rotated inward, resulting in a feathering action with the back of the hand downward. In the leg kick the recovery and propulsion are much shorter than in the conventional stroke.

FREE-STYLE TURNS

Having checked the stroke our next step is to work on the turns. The swimmer should be able to turn on either side and, according to the rules, he must touch the end of the pool with either or both hands.

From the very beginning have the swimmer appreciate that the turn is executed by whipping around with the head, shoulders, waist and hips, rather than by pushing the body around off the wall as support. As the leading hand touches the wall and even before, the head should be swung around facing the far end of the pool. In addition to the head the shoulders should swing into the movement and, following this upper body movement, there should be a twist in the waist, throwing the hips toward the wall.

During this time the knees should be drawn up in a tucked position to get the legs into a favorable position for the drive off the wall as well as for getting the hips as near the wall as possible.

During this turning motion the arm, which has pulled through to the thigh while the leading arm has been making the touch, should be rotated outward with a semicircular whip under the body. This helps turn the body and at the same time this motion keeps the body close to the wall. Both arms are then pushed forward into a position of full extension overhead, with hands together, and arms in close to the ears and elbows straight.

The legs are then extended as vigorously as possible to drive the body forward in a push-off from the wall. In this push-off the abdomen should be held in firmly with the buttocks tight, so that the drive with the legs will not push the lower spine into an over-extended position (See illustration in Exercise Chapter, Exercise 26.) If the lower back and abdomen are flat the pelvis will be strengthened against the drive of the legs and a gain in speed, will result. If, however, the pelvic muscles are all relaxed, a great deal of the power of the leg drive will be lost in the slack and loose pelvis. This is part of the streamlining of the whole body that was emphasized in the racing dive. After the body is well into its glide following the push-off, the legs should start their up-and-down whip, and the approach to the surface should be the same as the action following the start.

In teaching the turn the approach may be made at first with the head well out of water, so that the swimmer can easily determine whether the turn should be made on the right or the left arm.

In order to develop the whip motion in turning the swimmers should practice in the pool away from the wall, taking three or four strokes and then whipping around with the head, shoulder, waist and hip, aided by the action of the arms and the tuck, but without the support of the wall. After

the free turn has been made, the action stops and the movement is then repeated by command until the motion is mastered.

Having developed an ability to judge the distance in approaching the turn and also the whipping motion, go back to the wall and work on the turn with the swimming approach; turn, push-off and swim. Another thing to bear in mind is to speed up the stroke somewhat on approaching the turn rather than slowing it down. A great deal of time is lost by indecision in approaching the turn.

In free-style swimming two types of turn are used. In sprint swimming a so-called close turn is used, meaning that no attempt is made to get a breath in turning either on the approach, in the turn itself or in the first few strokes after coming to the surface. In middle-distance swimming the swimmers take a breath while negotiating the turn. This is done either by lifting the head a little as it turns or by keeping the head in its normal position but twisting it so the mouth comes to the surface, which enables the swimmer to get a breath. This is possible in middle-distance swimming and in long-distance swimming, because the time element is not as important as in sprint swimming.

BACKSTROKE TURN

In the backstroke the turn is executed practically the same as in the free style. The instant the touch is made with the leading hand the body is spun around by the action of the head, shoulders and waist; the hips draw the knees well up and prepare the swimmer for a drive from the wall; the free arm executes a sculling motion, or back-water action, which aids somewhat in the turn and also aids in helping to balance the body. After the legs get around and the feet are placed against the wall, the arms are extended overhead as in the backstroke start. The drive and the push-off under water, the leg and arm action are all the same as in the backstroke start.

Many swimmers use a somersault turn in the backstroke with great success. Here the start is somewhat the same as in the spin-turn, except that the head and arm on approach to the turn are dropped back as though going into a somersault. The knees are then brought up and the body is twisted, the action being a half-somersault, half-twist, the turn finally ending up the same as the regular backstroke or spin-turn.

BREASTSTROKE TURN

In the breaststroke turn both hands must touch the turning end of the pool simultaneously, and at the same time the head, shoulders, waist and hips enter into the twisting, turning motion as in the free style. The breaststroke swimmer, however, does not have the advantage of anticipating the turn as do the free-style and backstroke swimmers. Consequently it is even more necessary that the swimmer of this stroke become adept at turning. After the touch has been made with both hands the inside arm or the arm toward which the turn is made, can be whipped in a semicircular motion to assist in executing the turn.

BREATHING

Although we have touched on the breathing practice with which to open each lesson, there should be a further check on the breathing while the swimmer is in stroke. First, the coach should check to see that there is no holding of the breath; that there is good forced exhalation and inhalation all the time. This can be checked by watching the bubbles in exhalation and also checking the rhythm of the breathing. Also the shoulders, especially the shoulder of the under arm, should not be dropped too much while the breath is being taken. There is a tendency to drop the "off" shoulder to facilitate the breathing rather than by a twisting of the head. A delayed breath will also prevent roll and secure proper catch of the top arm. (See Illustration XXVIII.)

Immediately after inhalation through the mouth the breath is exhaled through the nose and mouth, and the entire time between inhalations should be taken up with the exhalation so there is no time wasted in the process. Practically all swimmers either breathe on one side or the other, breathing once to a full cycle of the arms, but they should all be taught to breathe on both sides. Many times changes from one side to another will help correct faults in stroke, especially in rhythm; furthermore, for a swimmer to watch all of his competitors in a race, he should be able to breathe on both sides.

Breathing every third arm instead of every second can be done as an aid in stroke correction, because it enables the body to lie in a flat position for a longer time. This will make the breathing come alternately on the right and then the left side. This is the type of breathing that was tried with some success in Europe between 1928-1932, the French and Hungarians being leading exponents, with Taris as the outstanding swimmer who used the method.

XXVIII. Shows delayed respiration with swimmer almost breathing under top arm, which assures a strong arm pull at top of stroke.

As nearly as possible there should be no distortion of the body position in breathing. Rolling has a tendency at times to throw the hips out of line, causing a weaving motion of the legs. The added friction and the rolling also destroy the efficiency of the arm stroke, especially on the beginning of the pull. The arms can't get into an efficient position until the body is flat on the chest, following the roll. Every effort must be used to keep the line through the shoulders parallel with the surface at all times, and to disturb this position as little as possible in breathing.

Breathing during the backstroke is much easier than in the crawl. Some difficulty is experienced by getting water up the nose at times in the push-off after a turn or in the push-off following the start. The neck in backstroke is at times extended so that the water is apt to run up the nose. This can be overcome by forced exhalation while under water, just as free stylers do.

BALANCE

The higher the body rides in the water the better, because such a position means reduced friction. As a general rule the head should be lifted, so

that the water line is just at the eyebrows. There should be no dropping nor lunging of the shoulders and no twisting of the hips, the body being as flat as possible throughout the stroke. The long axis of the body should be perfectly straight with no break in the shoulders nor in the hips. This can be observed by looking at the swimmer from behind and from in front rather than the sides. The long axis of the body will be broken by over-reaching, dropping the shoulders, the arms catching over the central line of the body or catching too high.

CHAPTER V

The Middle Stage

As has been indicated before, the competitive season is roughly divided into three parts. The first part is taken up with the fundamentals such as Starts, Turns, Breathing, Balance, Stroke, the ideal to be achieved and the techniques and disciplines involved in the teaching of these individual departments.

The middle third of the season may well be devoted to the development of endurance. The correct style having been dwelt on pretty largely in the first third of the season, the next step is to increase the work to achieve organic strength and endurance.

The third part of the season is devoted largely to a polishing of the skill in all departments and a tuning up through a study of pace to arrive at the peak of performance.

With this type of program in mind, it is well to try as far as possible to arrange a swimming schedule so that the season opens with meets that require the least output, followed in sequence by increasingly difficult competitions, until finally the culmination of the season brings into competition traditional rivals and the peak competitions, such as sectional and national championships.

Again let it be stated that the principal workout of each day should find the squad working together. Secondary workouts may be undertaken early in the season. At such sessions the coach should, by clear and careful analysis, point out faults shown up in squad sessions and should, by constant repetition of action by the swimmers in the water, eliminate and iron out such faults.

It is well to start each lesson with a short period of breathing practice. One cannot mention too often how important this is and how often faulty breathing is observed even in the best of swimmers. The muscles necessary for forced exhalation must be strengthened for rhythmic breathing, in which there is a quick, forced inhalation with the head turned to one side, but with the body in a stomach-down position; also the forced exhalation through the mouth or nose under water must be emphasized. The inhalation requires very little effort, especially if most of the air has been forced out in exhalation, leaving a partial vacuum in the lungs. Thus if exhalation under water

is not forced all the time, deflating the lungs as much as possible, the short period permitted for an inhalation will be seriously interfered with and faulty breathing will result.

The breathing practice should be done by bobbing up and down in a vertical position or with the body in a horizontal position, holding onto the side of the pool or to a kicking rail. At the same time the legs should be used in kicking practice. Another variation, shallow water permitting, is to stand on the bottom, bending over, with upper part of the body in the swimming position.

STARTS

The ideal start and certain difficulties in its achievement have been touched on in a previous chapter. However, further mention should be made in diagnosing possible minor difficulties that sometimes arise. For instance, in certain cases there is insufficient dorsal flexion of the foot; that is, there is an inability to flex the foot upward, toward the front of the leg or shinbone, which results in faulty balance in the crouched position of free-style and breaststroke starts. This insufficient flexion of the foot prevents the swimmer from allowing the knees and the upper body to be over the water at the pool's edge as far as possible, and forward of the mark in a hairtrigger balance. If this fault is discovered, stretching exercises should be practiced until a reasonable amount of dorsal flexion of the foot is possible, which will enable the swimmer to get a good forward balance on the mark.

Another fault to be observed at the sound of the starting gun, is that the swimmer often rocks back on his heels before getting into the air for his dive. This is also true of the arm swing, when a swimmer often exerts too much backward swing of the arms before they are brought forward.

Every effort should be made to have all of the body movement forward, following the sound of the starting pistol. The toes should be well hooked over the edge of the pool and the balance of the body on the mark should be carefully checked and watched. The swing of the arms may be at fault, and in some swimmers there is a tendency to straighten up from the crouched starting position rather than go forward at the sound of the gun. The swimmer should give his entire attention, after being put on the mark by his starter, to marshaling all his strength so as to get off the mark as quickly as possible.

All the steps necessary for a correct start require a great deal of practice and should be practiced repeatedly. A good start is a combination of the power in the swing of the arms, the drive of the legs and the quickness with which the swimmer leaves the mark. In practice as well as in a

race the swimmer should be taught that if he loses his balance in taking his starting position, he should never jump into the water. And neither should he take an easy, slow dive, for at all times his drive must have as much speed and power as possible. Not only does this help to establish the pattern of the correct movement, but there may be times when the starter can't see a beginning movement, and a weak dive or a jump into the water would be disastrous to the swimmer if the gun were fired under such conditions. Such advice is not to be taken as advocating a start before the gun, because every swimmer should be taught to hold the mark. However, younger and inexperienced swimmers in the excitement of competition may lose their balance.

Ways and means of increasing streamlining and distance in starts in free-style, backstroke and breaststroke have been indicated in the previous chapter. It is well to review these.

FREE-STYLE STROKE

The correct stroke has been indicated previously. We will now touch on ways and means of achieving skill and strength in the stroke.

Many times faults in arm stroke, leg stroke and general body balance in the water may be corrected by swimming forty or fifty feet without breathing, especially in the beginning. A great deal of faulty body position, with the resultant friction in the water, may result from a distortion of the body position while getting the breath, so that it is a real aid to have the swimmer go a short distance without breathing, in order that the flat body position, without any distortion of the shoulder or pelvic girdle, is maintained. In this way the swimmer can very quickly get the feel of the correct movements, including leg movements and body position.

In the arm stroke the catch, press, pull and push must be emphasized. Always one arm must be pulling and there should be an even application of power. Avoid any accent in the rhythm, either of the arms or the legs. Disturbances in rhythm are due, of course, to a drifting of the arm, possibly on only one side, with a quickening on the pull-through to catch up. This fault should be avoided and checked very carefully. There should be no side-slip of the arms, but the pull must be fairly straight from catch to pull-through, with no dropping of the elbows and shoulders on the catch.

Great care must be exercised in the application of the driving power in the legs and the pulling power of the arms. If too much power and speed are used there is a "washing-out" that is, at the beginning especially, and throughout the whole stroke there may be such a hard, fast pulling and

driving of arms and legs that a loss of traction results. On the other hand the pulling and driving movements of the arms and legs in propulsion must be energetic and with a gradual increase in the application of power. The kick should be kept under water as much as possible, but there are times, especially in sprint swimming, when the body rides high and the legs do whip out of the water. Roughly, the depth of the kick is about twice the length of the foot. Although the arm is relaxed in recovery, the fingers should be closed when the hand is pulling through under water. In teaching the proper rhythm of the stroke the legs should begin driving first and then the arms follow in rhythm.

To strengthen the stroke the arms and legs can be worked alone, aided by either added friction or added support. In the early tests the speed of the stroke using the arms alone was measured. It was suggested that this be done at the beginning of the exercise period, but it should be done again at the beginning of the water period. If the test indicates that the swimmer is weak with his arms, he can be given swimming practice with arms alone. The ankles are strapped, the legs being supported by some buoyant object like an inflated ball or a cork float. Then, the strength of the swimmer permitting, the swimming is done with the ankles strapped and no support.

If the swimmer complains that his legs sink and he is inclined to approach a semivertical or vertical position, he should be reminded that at a certain speed his body will stay in the horizontal position, and if he doesn't pull hard enough with the arms to get the required speed that he will start to sink.

This falling-off in speed defeats the purpose of the practice. Of course the distance to be swum in this manner should be increased, but the swimmer should never engage in this kind of practice without executing it properly; that is, with the correct arm stroke and with enough speed to keep the lower body and legs in the proper horizontal position. This type of practice can be carried out in the beginning, especially across the pool, but should be lengthened out later by swimming the length of the pool. This same practice with the legs tied can be conducted, overcoming the resistance provided by rubber belts, as illustrated in the chapter on mechanical aids.

Another aid in the correction of faults in arm stroke, as well as being an aid in strengthening the arms, is swimminig into mirrors that have been described and illustrated in a previous chapter. By swimming into the mirror with the head high out of the water, the swimmer can detect if the catch of his arms is too wide or whether it crosses the body. He can also see whether there is any side-slip of the arms. Swimming in this high position is also an aid in strengthening the depressors of the arms and is espe-

cially valuable for sprint work. It eliminates all sliding of the arms and provides a good position for the press in the catch of the arm stroke. The swimmer must avoid any tendency, while swimming into the mirror, to turn the head for a breath that will cause the opposite shoulder to drop. The shoulders should be level and the head high enough so that the breathing may be done directly in front without any twisting of the head. A five-foot mirror at the end of a 75-foot pool, tilted properly, will enable the swimmer to see his arm stroke for the full length of the pool. Swimming away from the mirrors the body should assume the normal swimming position, with perhaps a breath every third arm or every fourth arm recovery, in order to emphasize the flat position of the trunk in the water.

LEGS

An aid to the strengthening of the leg drive can be achieved through the use of a kicking-board or, as it is sometimes called, a flutterboard. With the swimmer lying on the board, the near end touching his chest, his arms extended and holding on to the side of the board, the swimmer propels himself forward with an up-and-down, undulating, whipping, alternate drive of the legs, which action is used in the free-style swimming stroke. This kicking can be executed either in an even, *legato* tempo, or in a sprint, staccato rhythm. A variation in practice would combine one, two or three lengths of the slow rhythm with a like amount of the fast type and, of course, variations of distance can be carried on to suit the strength and condition of the individual.

Another type of kicking practice that middle-distance swimmers like to indulge in, is to execute the kicking practice without the support of the board or any other object. In this kicking the arms may both be carried down at the side, executing a sculling motion of the hands at the hips, while the legs are executing their up-and-down motion. In this position, without the support, the body is much lower in the water, being more nearly in the position of the body in the actual swimming stroke. The head is turned to the right or left in breathing, as in regular free-style swimming, and it is well to practice breathing on both the right and left sides, as it is a decided asset to see the entire field in competitive swimming.

Another excellent conditioning aid is to have the swimmer practice in the swimming belt which is tied to the side or end of the pool. Not only is this an excellent conditioning activity, but at the beginning of the season a great deal of work can be accomplished in a limited space. In the average 30-foot-wide pool, only five swimmers without belts can work at one time.

With the swimmers working in belts tied to the side of the pool, twelve swimmers can work on one side of a 75-foot-long pool, so that by using both sides of the pool, twenty-four swimmers can be exercising in a full arm and leg stroke, instead of only five swimming up and down the long way. In this practice the coach can indicate a certain position to be maintained against the stretch of the rubber band. This is very valuable practice, especially with a buoyant swimmer who is apt to have a great deal of "run" to his stroke.

In this rubber-band practice this type of swimmer must overcome as much resistance as some of his less-favored teammates, who might be much heavier in the water. This rubber-band practice for a full stroke is one of the best conditioners that mechanical aids provide. It is much more valuable in free-style and backstroke conditioning than it is in breaststroke.

At this point great interest and variety in kicking practice may be added by the use of the rubber boots mentioned before, however.

Very little can be added to what has already been said under the heading of turns in the previous chapter. In teaching the beginner the free-style turn, the various steps can be executed on dry land. This can be done by walking toward a wall, throwing the leading arm in a whipping motion in a slide against the wall, spinning the head, twisting the shoulders and waist, and throwing the hips toward the wall all in one movement, while at the same time executing a back-water motion with the arm that makes the pull-through.

After these steps have been covered on dry land, they should be executed from a swimming position in the pool. At first the approach should be made with the head out of water, as though swimming into the mirror. In this way the swimmer can much more easily judge his distance from the wall and can much more easily decide in which direction to turn. Turns should be learned for both directions. After a certain amount of skill has been acquired in this high-riding position, the head should be dropped and the approach to the turn should be made with sprinting speed. Care should be taken to observe that the swimmer does not push himself around on the turn, but rather whips himself around; also that he begins to draw up his legs fairly soon because the delay of this movement will slow up the turn and he must also be checked constantly on the whipping, semicircular, back-water motion of the pull-through arm. This arm action aids in turning and also keeps the swimmer close to the wall. After speed has been acquired, individual team members can be pitted against one another in turning practice for the sake of comparisons.

BACKSTROKE

Very little can be added to what has already been indicated on the backstroke start in a previous chapter, other than the fact that on the signal by the starter to get into position, the swimmer places his feet high enough on the wall to get into a crouched position, pulls himself with partially flexed arms in close to the wall and on the pistol shot not only drives with his legs but also extends his elbows, pushing away with his arms and getting his body out over the water as far as possible. The spine is slightly extended with an arched back, so there will be a clean entry and the body will get under water. This action is necessary owing to the fact that the backstroke swimmer does not have the advantage of the 18-inch elevation to make a clean under-water dive.

The backstroke swimmer beginning his start at the water level, must resort to this arched-back position with the head thrown sharply back as well as the arms thrown back and well extended, not only in order to get as far as possible over water but also to get under water on the push-off for the start. As this arm, head-throw and arched-back position has a tendency in many instances to take the swimmer too deep under water if the body position is maintained, the start to the surface must be begun almost immediately after submersion of the head. This is done by raising the arms and pulling the head toward the chest. In the meantime the legs have started their whipping kick and, as in the free style, the first arm pull is finished just as the swimmer comes to the surface. If the back is not arched with the head and arms thrown back, there will be a tendency to have a rounded upper back which makes for a very poor entry as well as extreme resistance.

In the backstroke swimming position the body should be flat as in the crawl, with no tipping or lunging of the shoulders, and no twisting of the hips. The arm pull should be in the horizontal plane with no dig and dip and no washing out. The timing of the arms and legs should be such that there is no time lag, giving rise to an extensive feathering motion at the end of the arm stroke, a fault indulged in by many backstroke swimmers. This may well be the result of too deep and too wide a kick, especially from the knee. If the timing is correct, both arms will be pulling evenly and continuously from catch to recovery. Great care must be exercised so as not to overpull in the back-crawl arm stroke, which results in slip.

The strengthening practice in the water for the back strokers follows pretty much the free-style pattern. There is the same work for the arms, the legs being tied with and without support, and the same practice with the kick, except that it is done entirely in a position without support of the

flutterboard as in the free style. The kicking practice can be varied by having the arms extended overhead or by having the hands down at the thighs in a sculling motion. The same routines of slow work and fast work can be used in backstroke kicking practice. In the early season backstrokers seem to benefit by a certain amount of free-style kicking practice, and the free stylers seem to enjoy the same advantage by kicking in the backstroke position.

BALANCE

In the free style the body should be balanced in the water so that the water line is just above the eyes, and as much of the back and buttocks out of the water as possible, with the legs just low enough below the water surface to get traction at all times.

It cannot be emphasized too much that in the free style the body should be as flat as possible. In developing this position, of course, stroke, breathing, rhythm and floating ability all play an important part. In order to maintain the flat position it should be reiterated that the breathing must be done in conjunction with a twisting of the neck and not with a dipping of the shoulders. The flat position can also be helped considerably by waiting for the inhalation until the forward arm is well into its pull.

Another fault that distorts the correct body balance is crossing the arms in the catch. This, with the lunging of the shoulders, breaks the long axis of the body, throwing the hips out of line with the weaving of the legs. This position can be checked much more easily by looking down on the swimmer from above him, not only in profile but in line with the long axis of the body.

As has been mentioned before in the practice for getting a flat and correct body position, the swimmer can swim short distances without breathing. The next step should be to breathe every four strokes or six strokes over a short distance, and then cutting down the breathing time so as to keep the flat position by breathing every third arm stroke over a long distance, say 200 yards.

Finally, the accepted rhythm of breathing every two strokes on either the right or left arm can be practiced. Care must be taken not to use a jerky motion in taking the breath. Also care must be taken so after the inhalation the head is brought into a straight line with the spine. Many times the head in a face-down position is in a slightly twisted position, which has a tendency to drop the shoulder on the side opposite from the one toward which the head is twisted.

The amount of mileage or distance to be covered in the early preliminary period can, in the aggregate for the college age, run from 1,000 yards to a mile per session. For the younger swimmer of schoolboy age this should be half that distance or less, and should be divided fairly equal between work on starts, turns, stroke, polishing and the strengthening, kick and separate arm work. The sprinters will probably concentrate a little more on starts, turns and short, fast work than the middle-distance swimmers.

CHAPTER VI

General Program of Speed and Pace

THE EMPHASIS in the final period of the season, the last third, is on polishing the stroke, paying attention to small and detailed items and speed, and the proper distribution of energy which must be directed toward pace.

There must be a constant check on the correct form of the arm stroke, the leg stroke and above all the breathing. Balance in the water must be watched, and if the swimmer is too low in the water vigorous retraction of the abdomen should be practiced while swimming, together with a rolling of the pelvis, so that the lower back is flat instead of being arched. This movement will have a distinct tendency to raise the body higher in the water, even with swimmers who have limited floating ability.

RELAYS

Considerable time can be spent on starts for individual races and relays. Swimmers can experiment with stance and balance to get the feel of the most advantageous angles in ankle, knee and hip joints, while in the crouched starting position. Relay starts can't be practiced too much. Not only must a relay swimmer's start be as good as one in a flat race from the gun, but he must also be able to take the full advantage of the time allowed. In swimming at the college level, for instance, the advantage to be gained in a relay start over a gun start is approximately one second. To take full advantage of this opportunity requires a skillful "take off." The swimmer leaving the mark is almost fully extended out over the pool as his teammate touches in, the rule requiring that the starter be in contact with the mark when the preceding swimmer touches the end of the pool. In this "end of season" practice the make-up of the relay team should be fairly well established, so that with a regular sequence in "take off" among the same swimmers on a team the greatest efficiency in "take off" timing may be achieved. In relay starts greater distance may also be gained because more time can be taken in the wind-up than in the gun starts. In this relay practice the swimmers coming in should be moving as nearly as possible at the same rate of speed and with the same stroke-timing as would be used in an actual race.

SPRINTS

Of course, breathing in sprinting races varies somewhat with different swimmers, but in the main, 50- and 100-yard sprinters may be irregular in their breathing. The reason for limited breathing in sprinting is to cut down as much as possible the friction caused by rolling. With regular breathing, this resistance and breaking of the stroke rhythm seems to be greater while breathing in sprint swimming than it is in middle-distance swimming. In races over 100 yards the breathing should be regular, coming on every uplift of the right or left arm. Swimming a 50 in a standard short-course pool of 25 yards, most swimmers take one breath the first length of the pool and one or two breaths during the second. The breath which is taken during the first length is timed for just before the turn; the breath in the second length is timed for the middle of the pool when one breath is taken, and at the one-third and two-thirds spots when two breaths are taken.

In the 100 several timings in breathings are in vogue and these may be all tried, choosing the one which gets the best results. Some 100 swimmers breathe in regular sequence and they may take more than one breath on the first length; a breath every fourth arm pull on the second, and regular breathing on the last 50. Others breathe as in the 50 for the first two lengths and then regularly the second 50. Various combinations should be tried: Forced deep breathing for two or three minutes seems to make it possible for these sprinting competitors to get along comfortably with a limited oxygen intake.

All swimmers should be able to breathe on both sides, so if the occasion demands an opponent's position may be observed.

The proper finish of a race should also be practiced. Stroke selection, whether to finish with the right or left arm, is important. How to finish, how to space this action, requires considerable polish. The swimmer must develop the ability to determine whether to extend a stroke and lunge for the finish, or whether to take a fast short additional stroke. If the distance to be covered is too great, a lunge finish may result in a "drift in" which is too slow. On the other hand, if too many strokes are taken at the finish for the distance to be covered, many times an opponent can touch out a rival with a lunge and vice-versa. This skill in the selection of which arm to thrust forward at the finish, or whether an additional short fast chop should be used, ranks with the same importance as the space sense acquired in stroke spacing on the turns and in the relay "take off."

BACKSTROKE

In the backstroke the check-up is the same as in free style. There should be a careful scrutiny of arm stroke, leg stroke and body position at all times. At the start the drive of the legs and the extension of the arms from the starting grips should be so co-ordinated that the greatest distance and speed will result. Too often backstroke swimmers don't utilize the push off with the arms, seeming to regard this function of the arms merely as a help in lifting the body as far out of the water as possible.

Breathing in the backstroke presents few problems because of the favorable body positions. However, in making the turn, the backstroker does go under water and here he is in a much more unfavorable position. The extended position of the head and the obliquely downward position of the nasal passages makes it imperative that the swimmer exhale throughout the push off in order to keep the water out of the nose.

In stroking for the turn, sight on the end wall should be made at the beginning of the arm recovery, not in the middle or end of the recovery when the arm position may obstruct the swimmer's view of the end wall.

The same sense of spacing should be developed by the backstroker as was suggested for the free-style swimmer on turns and finish. This is even more important because the backstroker cannot change from a lunge "pick up" stroke to a short-arm accelerated stroke as easily as the free styler can. He therefore suffers a greater loss of time if his judgment is faulty.

BREASTSTROKE

In the breaststroke there should be the same careful check-up on strokes, with special attention being placed on the finish movement of the arms and legs. Breaststrokers have a tendency to float their legs at the finish of the stroke and to cut short on the arm stroke.

The body position must be as high as possible. In the glide the hands are on the surface with the elbows fully extended, the abdomen is retracted, the lower back flat, the buttocks out of water, the knees extended, toes pointed and the heels out of water if possible. The body in this gliding position should be active but not tense. Too often the swimmer relaxes too much in the glide. In the active part of the stroke, as in the glide, whether in the conventional stroke or in the butterfly, the pelvis should be held in a firm, strong position. Too much relaxation in the middle of the body results in an angle of the torso which causes greater friction and faulty rhythm. The legs must have a firm base from which to drive. In the conventional

stroke check any erratic rhythms in the stroke. One of the most common faults might be termed "rocking horse" action. There is a bobbing up and down in the glide which should be smooth. This is caused by the fact that the head is kept up too long after breathing and isn't dropped into position until after the glide starts. The breath should be taken quickly and the head dropped into position before the legs begin their thrust.

In sprinting in the breaststroke many swimmers take two strokes per breath and, if this can be tolerated by the individual swimmer, greater speed can be developed because of the better body position over a greater period of time.

The stroke-spacing on turns and finishes in the breaststroke is a bit different than on the other strokes, because the rhythm is broken in contrast to the continuous rhythm of the crawl and back crawl. If on the turn or finish the breaststroke swimmer finds himself short of the mark he can easily adjust himself to the space by taking an extra kick and keeping his arms extended in the glide position. This is a very valuable maneuver in medley relay "take offs" where the breaststroke man swims into the free styler. Because of the lower ratio of speed in the breaststroke, the free-style starter can gain much time if the breaststroke "swim in" and the free-style "take off" are properly executed and timed.

PACE

We now come to pace, by which the energy of the swimmer is so distributed that the greatest speed is achieved. Certainly by this time of the season when the swimmer is well-conditioned through his distance swimming of the early season, he can now experiment with various speeds for various distances as outlined by himself or his coach. In the beginning of the pace-training work a modest schedule should be tried, and as more exacting schedules are attempted they can be at first swum over part of the distance. The mark of the champion is the ability to hold an even pace, one in which there is no "fall off," especially in the middle distances (220, 440, 880 and mile). Not only does this training put the finishing touches to the speed conditioning, but it also enables the contestant to learn how to judge or estimate his own speed, staying on a schedule instead of being slowed down or "pulled out" by a competitor. In the sprints, as compared with the middle-distance swimming, there is a greater "fall off" in speed as the race progresses, owing to restricted breathing and the terrific energy output.

To enable the swimmer to know how near he is on a pace schedule set

for each 50 yards, some check on the time should be made and indicated by a flash of under-water lights, by a pistol shot, or the blowing of a whistle. By such means the swimmer knows whether he is on, ahead or behind his schedule. To the above schemes may be added a pacing machine. Here the swimmer follows a mechanical object or "rabbit" which moves at an even pace up and down the pool, along the pool deck or just over the water.

In building a schedule in the free-style events the 50 should be "swum out" all the way. In the 100 the first 50 should be done about one second less than the swimmer's top. In the 220 the first 100 should be approximately four seconds slower than the swimmer's best 100, and in the 440 the first 100 is about five seconds slower than the swimmer's best 100.

All of these split times suggested above are a bit faster than the pace which can be sustained by the champions. These top-flight swimmers might swim about a second slower on the way.

In the backstroke, as in the free style, the 50 is taken out all the way. In the 100 the first 50 is about one second slower than the swimmer's best, and in the 150 backstroke, the 100 is about two seconds slower than the swimmer's best.

In the breaststroke the 50 on the way to 100 is about one second less than top, and the 100 on the way to 200 is done about three seconds slower than the competitor's best.

Of course these estimates must be changed somewhat for different swimmers, that is, with the seasoned and more experienced swimmers not going out quite as fast, whereas the younger swimmer must make the most of his energy earlier in the race. However, the tendency should be to spread out the race and have the pace as even as possible.

Constant changes in schedule are necessary due to the development and improvement in speed swimming, therefore, instead of including schedules here the writer urges coaches and swimmers to consult the championship meet reports for the detailed time schedules which appear in the reports of current meets as well as those of the past. (See N.C.A.A. and A.A.U. annual guides.).

CHAPTER VII

Training

In the prewater-conditioning period of the season, during the time in which the free exercises are used, comparatively little attention is paid to any strict training code. Rules compatible with a regime of health are observed but with no strict adherence to any rigorous code. This is because there is no attempt to achieve competitive excellence; neither is there any attempt to move toward a physical peak of conditioning fineness.

However with the first lesson in the water the training ideal should be explained and emphasized; the whys and wherefores of the training regime should be gone into and explained very carefully and everybody should be put on his honor to observe them. A training code to be observed provides the finest discipline possible for young men. One might almost say that in our present urban civilization it is the only combination of physical, mental and emotional discipline afforded the youth of our nation.

It is agreed, of course, that swimming is a fine physical exercise and has great safety value, but the things to be emphasized in swimming training are the benefits to be derived not so much in the achievement but from the striving and discipline that comes in the attempt to reach a goal.

Only in competitive athletics contrasted with recreational sports and informal athletics does one get great emotional lift. There are so many unpredictable factors which, while exacting very intense training, also afford great satisfactions. There should always be a goal of adherence to and sacrifice for the group, a goal of individual achievement, but always and uppermost the idea of striving should be kept in mind. The participant should seek accomplishment, of course, but he should always work to do a little better.

The young swimmer should be encouraged and his energy kept in check and directed in the proper channels, and the veteran should be always reminded of the amateur ideal—never to lose the spirit of striving. Emphasize the fact there should never be an alibi or an explanation. Everyone expects an athlete to win and very few people care about one's hard luck. Boasting or alibiing never have any place in the athlete's code. It should be pointed out again and again to him that little thought should be given to physiological limit, but that whatever limits there may be in

performance, are purely psychological. In other words, one can almost will to do what one wishes to do.

Swimming, from the standpoint of technicalities, has changed comparatively little in the last ten or fifteen years, and yet record times all along the line in international, national, intercollegiate and interscholastic competition have gradually become faster in all races. This increase does not approach the speed of which the modern top flight or even average swimmer is capable. If this inhibition could be removed psychologically the increases in speed would be almost limitless. This inhibition, of course, consists largely of a feeling that it is only a few gifted persons, the champions, who can swim in the top-flight brackets. However, there are outstanding examples that can be pointed out where, because of some particular stimulus, the athlete has risen to the occasion and has turned in a record time that was way beyond his fondest hopes. The example of Borg as quoted before is an instance.

Furthermore, many examples in track and field may be cited to bear out this contention. Everyone can think back ten years when the technique of swimming was about the same as it is at the present time, when training methods were practically identical and the time for the 220 was, let us say, about 2:20; and yet today men in the same class of competition are doing about five or six seconds faster. In the 440 ten years ago top-flight swimmers were turning in about 5:00 m. Today the same class of swimmers are turning in 4:50 performances.

The contention in all this argument is that if the young swimmer can be taught to believe in himself and to have confidence in his abilities, that physiologically there is no limit to what he can do. The drawbacks are psychological; lack of sufficient confidence. Of course progress is being made and the increasing speed is coming gradually, but if enough inspiration is given the young swimmer and he is endowed with enough imagination, all things being equal, there is no limit to the results he can achieve.

At this first session other training items should be stressed. Eight or nine hours sleep a night, regularly, is a necessity. The diet should be plain, wholesome food with no rich desserts, and avoidance of any fried foods. Milk should form one of the regular items and it should only be avoided before competition. As a matter of fact, the amount of liquids should be cut down considerably three or four hours before competition. If possible, there should be some rest before meals. It is poor practice to eat when excited or tired.

Needless to say, tobacco and alcohol should never be permitted under any circumstances. A strict recording should be made of the weight, prefer-

ably at the same time each day. This knowledge is of great value in determining an athlete's condition. A falling off in weight may indicate the onset of staleness, and when any such fall-off occurs, every effort should be made to regain the swimmer's best competing weight.

On the personal hygiene side the best of care should be given the respiratory tract, because of the peculiar conditions connected with swimming—the difference in breathing and the necessity of getting water into the nose, subjecting nose, throat and ears to possible infection.

The nose should never be cleared by blowing out, but should be cleared by inhalation through the nose and clearing out through the throat. Forceful nose blowing may result in driving infection into the sinus and ears.

Inasmuch as changes of temperature play such an important role in swimming practice, with the constant diving into water of one temperature and standing around in the nude between heats on the deck of a pool where another temperature prevails, it is important that temperatures and humidity be kept at the proper levels in the natatorium.

It is generally agreed that the water should be kept at the temperature of 72 to 75 degrees, and the temperature of the air 10 degrees higher. But what is more important, that the relative humidity should be around forty per cent.

This humidity item is very important. Dry air seems to affect the swimmer more unpleaseantly than any other athlete, due to the fact that the air is inhaled with such a forceful manner. If the relative humidity is low this harsh intake of air has a tendency to irritate the throat. With a low relative humidity the extreme evaporation creates a feeling of chill no matter how high the temperature of the air on the deck. On the other hand, if the relative humidity is too high, that is, well over fifty per cent, the condition results in a feeling of enervation and depression.

The effects of the chilling that often results from getting in and out of the water so much, make it imperative that the swimmer be very careful on leaving the pool not to expose himself unnecessarily to a change in temperature. His hair must be thoroughly dry when he leaves the natatorium, and he must wear a hat out-of-doors. A muffler should be worn in the winter and the feet should be kept dry and enough clothing should be worn to avoid any chill.

On leaving the pool the swimmer should avoid a hot bath, because too much warm water is enervating. If a bath is to be taken, a quick, cold shower is recommended. During practice on the deck of the pool a sweat suit or bathrobe should be worn to avoid drafts and chilling.

Great care should be exercised in the supervision of the health of swim-

mers to check on any cases of athlete's foot. Such cases should be immediately subjected to treatment by a physician, principally to avoid secondary infections that many times keep the swimmer out of the water for weeks on end.

Another peculiarity that is noted at times, especially with backstroke swimmers, is when they take a gulp of air on the turn. The air is swallowed and sometimes enough air is taken into the stomach to cause great distress. Of course, the way to avoid such difficulty is to break the habit of such action on the turns. It is easy to detect because the swimmer takes in the air with a loud gulping or sucking sound.

Much has been said concerning the coaching treatment of athletes with a variety of temperaments, and this cannot be emphasized too much. Of course all people are sensitive, but some to a greater degree than others. The stolid, phlegmatic boy possibly requires more driving; the nervous, high-strung type requires a restraint and more subtle direction, but all must be held to a high standard so that their fullest capabilities are developed.

Of course, it is the aim of the coach to bring his entire squad to the peak of condition at a certain time of year; in most instances in the final third or quarter of the season. A squad of any size will have many different emotional temperaments, great differences in strength and skill, and swimmers of varying experience. The greatest problem for the coach is to keep the young, inexperienced swimmer from reaching the peak too early.

Most athletes, working on a plan of a peak in performance, try to achieve that condition at a certain time. In most instances the longer this peak condition can be held the more successful the athlete's season. Most young swimmers arrive on this peak plateau too early, stay there too short a time, and then fall off, unable to return until the following season. This is undoubtedly due to their exuberance and enthusiasm. It is the coach's problem to harness this emotional drive, conserving it as much as possible, so that the peak plateau is reached as late as possible and held as long as possible.

It is the writer's experience that this peak plateau is reached a little later with each year's experience and the condition held longer. Every effort, of course, especially with the young athlete, should be directed toward conserving energy and toward relaxation. There may be lots of work but not too much resting, and if it were possible to get along without time trials that would be the ideal situation. However, with a big squad, in order to give every man his chance and in order to place the men properly in events, some time trials are necessary, though these should be kept to a minimum.

Although time trials should be given only when positively necessary,

it should also be emphasized that the more mileage covered by a swimmer through the years, year in and year out, the greater the chances for success, especially in middle-distance swimming. There is no easy road nor short cut to organic strength and vigor. This constitutional power can only be built as in the case of the development of muscular power, by intelligent application of work, work, training and work, *ad infinitum*. This is the sort of conditioning that cannot be bought in pill-form over the counter, and athletic achievement and success, like all good things in life, can only be bought through hard work, sacrifice and discipline.

Much has been made of peak condition. This should raise the question of staleness. Staleness may be caused by a number of things, such as lack of interest and overwork. About the only remedy is a layoff. However, experience has taught me that once the athlete is past his peak of condition it is hard to get him back to form before the succeeding season.

It is well for all swimmers to be capable in all styles of swimming, as the interchange, especially between backstroke and free-style, is very beneficial and there is a certain satisfaction in being an all-around swimmer. In the off-season, water games and play are good for conditioning. It is also an excellent plan to have all members of competitive swimming squads pass the Red Cross Lifesaving tests. Organizations fostering all-around swimming are also recommended for the purpose of creating general aquatic ability in the competitive swimmer.

MASSAGE

Massage is a worthwhile luxury, but not essential to a swimmer. In massage a rubbing oil may be used over the whole body after practice, but if a massage is given before practice or a race, oil should be used only on the trunk and should not be used on the arms or legs, because the swimmer wants to get the greatest possible traction with his arms and legs in propulsion.

Alcohol should be used on the arms and legs as it clears the skin of any body fats or oils. In the case of swimmers who are apt to be a bit stiff, application of hot towels on shoulders, thighs and anklejoints, twenty minutes to a half hour before a match, has been found to loosen up a swimmer considerably.

TRAINING CONDITIONS RELATED TO COMPETITION

The swimmer should never eat less than three hours before competition, and the amount of food eaten before a race depends somewhat on the temperament and the tolerance of the individual. Some people can eat a fairly heavy meal, whereas others can tolerate but little food due to emotional distress. The athlete who experiences intestinal distress should have his last meal moved back further and further until this distress is eliminated.

Some individuals are also allergic to certain foods. All this requires experimentation. In the main an athlete can take a meal something like the following, three hours before competition: a little clear broth, a chop and baked potato, or cold meat and baked potato; tea with lemon and plenty of sugar. If the race is four hours after the meal, a dessert like ice cream may be permitted.

On the day of the match, if any swimming is done by the competitor at all, it should be very light. Many coaches prohibit any swimming at all. However, an hour or forty-five minutes before the match, it is a good plan to have the swimmers warm up slowly with a 300- or 400-yd. paddle.

When competing in outstanding competition away from home, and time permits, the team should arrive at the place at which the meet is to be held not later than thirty-six hours before the competition. Any period short of this is not sufficient to straighten out the kinks resulting from traveling in a cramped position, and doesn't give enough time for the men to become thoroughly rested and acclimated to new conditions. Of course, as much time as this isn't always possible, but it is recommended when a team is competing in the top meets of the season.

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