

The Cabbage That Wed a Radish

Botany—Genetics

By FRANK THONE

Once upon a time there was a little cabbage. She lived in the garden of a Russian scientist, who, quite contrary to popular notions, did not look like either Santa Claus or Emil Jannings. He was young, smooth-shaven, and good-looking enough to turn other heads than those of cabbages. His name was Georgii D. Karpechenko, which doesn't sound any queerer in Russia than George D. Carpenter would here.

But it wasn't for the young Russian scientist that the heart of the cabbage fluttered. She was mated to a fiery French radish, a distant cousin of hers, and Dr. Karpechenko was merely the squire who officiated at the wedding. And afterwards when the babies began to arrive (thousands of them!) he kept official record of the posterity of this strange wedding.

A queer posterity it was, too. For there seems to be a prejudice against marrying too far out of the family, in our neighbor world of plants and animals. Mate a donkey and a horse, and you get nothing but mules. Mate a carrot and a beet, and you get—nothing at all. The relationship is too remote. For the breeder the rule is always, make your matings relatively close; the more distant the cousinship, the less chance you have of obtaining offspring, and the less chance the offspring you do get have of amounting to anything. There are a few good hybrids that have become standardized—the mule, for example—but for every success resulting from these out-of-the-family matings there are thousands of failures. The great majority of hybrids are worthless.

It was so with the radish-cabbage wedding that took place under Dr. Karpechenko's hand in the garden of the Institute of Applied Botany at Detskoe Selo, near Leningrad. The offspring were neither cabbages nor radishes, but merely queer rosettes of leaves. They did not make cabbage heads above the ground nor radish roots beneath. In fact, they resembled, outwardly at least, the tufty little ancestral cabbage plants that still grow wild on the cliffs along the North Sea shores. That is the fate of many hybrid crosses; they produce what look like "throwbacks."

Yet in spite of the unpromising looks of the radish-cabbage children, Dr. Karpechenko cultivated them care-



GEORGII DMITRIEVITCH KARPECHENKO, who mated the radish with the cabbage

fully, saved such seed as they formed, and took tender care of the grandchildren plants also, though they turned out no better than their parents from a gardener's point of view. Why? What good reason could a geneticist in a government Institute of Applied Botany give visiting officials, who were not scientific, for using good ground to raise such weeds?

Well, for one thing, Dr. Karpechenko had done a thing rated as almost impossible; he had made an "intergeneric cross." And no matter how useless they may be, the offspring of an intergeneric cross are such great scientific curiosities that their mere existence is sufficient justification in itself. They are scarcer than two-headed calves or mathematical horses. Only once before in the history of plant breeding do we come upon a record of a cross between a radish and a cabbage. That was made by an American, Dr. G. F. Gravatt of the U. S. Department of Agriculture, back in 1910; but unlike the present hybrid, it was completely sterile and left no descendants. So, on the basis of rarity alone, the job was justified.

To most of us, a hybrid between a radish and a cabbage may seem no more remarkable than that common-

place cross that provides us with mules. But there is a difference, and a big one. For the donkey and the horse are distinct species, to be sure, but nearly related and belong to the same genus; whereas cabbages and radishes, though still related to each other, are at best quite distant cousins and belong to different genera.

According to the naturalists, a species is made up of individual plants or animals quite similar in hereditary make-up, and usually also in appearance, unless breeding and selection have split it up into distinguishable varieties. Thus, all black oaks belong to one species of oak, and all white oaks to another; and in nature all black oaks look more or less like each other, as do the white oaks. All dogs are of the same species, but here artificial breeding has split the species up into separate varieties or breeds, ranging all the way from Pomeranians and Mexican Hairless to St. Bernards and Newfoundlands. Similarly artificial breeding has split up the original cabbage stock into Brussels sprouts, kohlrabi, cauliflower and several distinct varieties of true cabbage; but these are all children of one species, all varieties of the original stock, known to botanists as *Brassica oleracea*.

Each genus is made up of a number of independent but related species. Thus, all dogs and wolves are included in the genus *Canis*, and all species of oaks in the one genus *Quercus*. Included in the cabbage, or *Brassica*, genus are species that we know as turnips, rutabaga, rape, kale, and the two Chinese cabbages pe-tsai and pak-choi. Crosses between separate species within a genus are easy enough to make; our old friend the mule comes into the picture here, and many varieties of our domestic poultry. The table grapes of the eastern United States are most of them interspecific hybrids, and many of our new and choice western wheats seem to belong to this category. Of course, crosses between varieties within a species are even more abundant; see any mutt dog or alley cat or scrub shote if you want to study the subject.

As species are grouped together to form genera, so related genera in turn are grouped together. Oaks, beeches and chestnuts, for example, are grouped in this way; cats, lions and tigers, and cabbage, radishes, mustard and cresses. But hy- (Turn to next page)

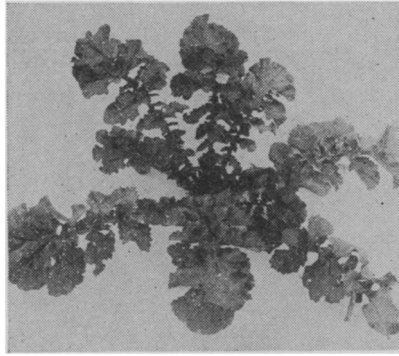
Radish-Cabbage Match—Continued

brids between separate genera are exceedingly rare, and it is in having secured such a cross that Dr. Karpechenko's scientific triumph lies.

Another value in the work of this young Russian may be found in its possible bearing on the study of evolution and the origin of species. There are in existence a considerable number of plant species that resemble related forms in general shape and growth habit, but are so much larger and more vigorous that they are usually considered quite distinct. Coupled with the larger general growth habit is an internal difference that can be found only with a microscope; the bigger plants sometimes have two, three or four times as many chromosomes in a cell as the smaller ones. For this reason some students of plant life believe that the larger plants are nothing but hybrid forms—small plants multiplied internally, as it were.

Chromosomes are specialized bits of denser protoplasm, the "bearers of heredity," according to most biologists, that are to be found in every actively living and dividing cell. In any given species each cell of every individual contains exactly the same number of them as all the other cells. At a certain stage in the reproductive process the number is reduced one-half, but soon thereafter the original number is restored. Biologists have therefore come to look upon its chromosome number as one of the marks of a species, quite as constant as size of seed-pod or shape of flower, and much more dependable as a means of identification than flower color or leaf shape. By crossing a radish and a cabbage, Dr. Karpechenko has succeeded in doubling, trebling and otherwise changing the number of chromosomes in the cells of the hybrid children and grandchildren of this old pair, and thereby gives the students of heredity something more to work on in their pursuit of the ever-elusive riddles of evolution. So, even though the descendants of the cabbage that married a radish will never appear on any dinner table as salad or sauerkraut, they will figure in the dry but important tables of figures compiled by geneticists.

After we have come to a realization of the commercial uselessness of the new hybrids and their sharply contrasting importance in the scientific field, they may be looked upon from a third angle, as objects of great curiosity and interest to the or-



ONE OF THE CHILDREN of the radish and the cabbage

dinary, non-specialized, average citizen. The marks of their double parenthood stick out all over them. You can put your finger down on almost any part of one of these hybrid plants—should one call them "raddages" or "cabbishes"?—and pick out, here a radish character, there something of unmistakable cabbage origin.

The leaves, for example, have more of the radish shape and arrangement. They never try to head up, but remain as a loose rosette rising a little above the ground. The nearest they come to being a cabbage is to look a little like their old wild ancestor. But though radishy in shape, they are a little cabbagy in texture, being less hairy than typical radish leaves. This habit of forming only a rosette of leaves near the ground persisted into the second generation or grandchildren of the original cross, even though these were again crossed with head-forming varieties—cabbage and Brussels sprouts.

The roots of the hybrids were plainly enough hybrid roots. They were not thickened up into the nice edible globes or spindles that radishes make, but neither were they so strictly thin and fibrous as the roots of regular cabbages. Even in the second generation crossings with cabbage this trace of the radish in the roots still persisted.

When they came to produce their flowers, the hybrids again favored both sides of the house. They produced big, bushy growths of stalk, rather more than either parental type usually grows, and these stalks were heavily burdened with white flowers, intermediate in size and shape between cabbage and radish flowers. Inside, the stalks tended to be like those of the radish, for they were hollow, and the cabbage stalk is typically solid.

One unusual feature about the flowers in the hybrids with extra chromosome counts was the tendency to produce extra stamens. The normal stamen number in both radish and cabbage is six, but in these atypical plants there were sometimes eight stamens.

Perhaps the oddest thing about the structure of these cross-bred plants, and at the same time the most easily noticed, is the way the seed pods are put together. Cabbage seed pods are long, slim affairs, opening on the sides with a pair of trap doors running down the whole length, and shedding their seeds through these openings. Radish seed pods are thick and stocky, with a tapering tip; they have no natural mode of opening at all, and release their seeds only when crushed or after they lie on the ground and decay. The pods of the hybrids are of about the same size and shape as radish pods. They have trap-door openings through which the seeds escape, cabbage fashion; but these run only about half-way from the bottom to the top, and the rest of the seeds are left inside the pod to get out as best they can, after the manner of the radish! Nothing so queer has ever been seen in all the half-way compromises which hybrids have had to make between their two parents.

Dr. Karpechenko, fascinated with the results of his first match-making efforts, has also crossed radishes with Brussels sprouts, kohlrabi, turnip, Chinese cabbage, and several wild *Brassica* species. He has also used instead of the radish a wild species distinct from the cultivated kinds. The technical statement of his results has been published in Russian, and is now being prepared in an English version.

The American predecessor of this Russian radish-cabbage hybrid was described fourteen years ago in the *Journal of Heredity*, but did not attract much attention at the time, and since the strain died out for lack of seed was lost sight of and pretty well forgotten. The description then written by Mr. Gravatt, its originator, tallies fairly well with that now given by Dr. Karpechenko, but differs in some respects. For one thing, Mr. Gravatt's hybrid had leaves more like a cabbage, but they were much larger than the leaves of either parent. The largest of them was five feet nine inches from tip to base of stem, and one foot seven (*Turn to next page*)

National Hydraulic Laboratory Urged

Engineering

A solution to the problem of what governmental agency shall be in charge of a national hydraulic laboratory, if one is to be established, is being sought in hearings before the House Rivers and Harbors Committee.

The Senate has already passed a bill which would establish a national hydraulic laboratory in the Bureau of Standards, but in hearings before the House Committee, both last session and this session, Army engineers have opposed the bill, maintaining that such a laboratory should be under War Department supervision.

Dr. A. W. Beresford, president of the Engineering Council, has appeared

“Raddage”—Continued

inches broad. It was intermediate in color between radish and cabbage, and tasted like a cabbage leaf slightly flavored with radish. It was nearly smooth—again like the cabbage. It grew into a tremendous bush, filling one end of the greenhouse where it was set. Before it died of a bacterial root rot, it had grown out of the ventilator of the greenhouse and part-way down the roof on both sides. It bore huge numbers of flowers, but never set a single fertile seed.

A recent issue of the *Journal of Heredity* contained an account of a strange cabbage hybrid originated by a Polish experimenter, C. Moldenhaver. This was a cross between cabbage and Brussels sprouts. As we have already seen, this is not so difficult a thing to get as the intergeneric cross between radish and cabbage, because cabbage and Brussels sprouts are very closely related, being simply cultivated varieties of the same species. But Mr. Moldenhaver's hybrid nevertheless has its very interesting points. It grew a tall, erect stalk, after the fashion of a plant of Brussels sprouts; only the stalk was much taller than its parent variety. On this, at each place where the small, bud-like “sprouts” usually grow, appeared a great, loose rosette of leaves, obviously trying to be a cabbage. If this hybrid could only be improved a little, making it possible to grow six or eight full-sized cabbages on a stalk instead of only one, what a fine world it would be for the makers of sauerkraut! *Science News-Letter, February 9, 1929*

There is one automobile in Russia to each 7,000 inhabitants.

in favor of the bill as it stands, declaring that the work is research work and that the work of Army engineers is definitely practical. Army engineers should be able to bring their problems to the laboratory when they desire and have research men work on them, he said.

It would be undesirable, Dr. Beresford maintains, to strike out from the bill the phrase relative to the work to be done by the Bureau of Standards, which reads: “including laboratory research relating to the behavior and control of river and harbor waters”, but to strike it out completely would be better than to change the

Calves Inherit Disease

Genetics

Calves born with “raw places” on their skin or on the mucous lining of their mouths and noses have been troublesome problems to animal breeders. They have been expensive problems, too, because they invariably die, apparently from infections contracted through the exposed surfaces. For this reason Dr. F. B. Hadley and Dr. L. J. Cole of the University of Wisconsin have conducted a study on the heredity of this defect, and have just reported their findings.

The defects observed by the two Wisconsin scientists have all occurred in herds of Holstein-Friesian cattle, but somewhat similar defects have been observed in the Brown Swiss and Shorthorn breeds. The defects in the Wisconsin Holstein-Friesian cattle all trace back to the same group of ancestors. Study of the cases where they have cropped out indicates that the lesions are due to a genetic trait of the kind known as “recessive,” which expresses itself only when both parents carry it in their germ cells. Feeble-mindedness in human beings is a familiar example of a recessive character.

To get rid of the defective strain in a herd completely and immediately would involve more drastic weeding out than would be economically justifiable; in the opinion of Dr. Hadley and Dr. Cole. They suggest instead the elimination only of bulls whose offspring show the defects and the substitution of sires whose pedigrees are clear so far as hereditary skin defects in the family are concerned.

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word “including” to “excluding”.

Dr. G. K. Burgess, director of the Bureau of Standards, believes that a compromise can be effected which will please both Army engineers and civilian engineers, the latter of whom have come out strongly for the bill.

He anticipates a change in the language which would allow workers in the hydraulic laboratory under the Bureau of Standards, to engage in “laboratory research relating to the behavior and control of navigable waters at the request of the Board of Army Engineers.”

Science News-Letter, February 9, 1929

Jewish Students Score

Psychology

Jewish college students outshine other nationalities in their class work, according to an investigation made by Prof. Henry E. Garrett, of Columbia University, reported in the *Personnel Journal*.

Professor Garrett studied the differences between 296 representative freshmen at Columbia, and found that the Jewish students are far superior both in intelligence test scores and in classroom grades. Students of Italian ancestry do better work than would be expected from their intelligence ratings, whereas with the Irish students just the reverse is the case.

“Classified as to religion, the Hebrew students rank higher than the Catholics and Protestants,” Professor Garrett reported. “There were no significant differences between Catholics and Protestants.”

Native ability may be the cause of the superiority of the Hebrew students, he suggests, but apart from this there are two other possible contributing causes:

“In the first place, it is very probable that the preparation of those Jews who apply for admission to Columbia College is on the whole better than that of the other applicants. Secondly, the standards or criteria for admission are probably somewhat higher for Jewish students.”

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Government educators say that India has made more important and far-reaching changes in higher education since 1920 than any other country.