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Inaugural Poggendorff Memorial Lecture: Walter Poggendorff - Pioneer Plant Breeder

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This Inaugural Poggendorff Memorial Lecture was delivered on November 6th, 1986, at the Hawkesbury Agricultural College, Richmond, in memory of Walter Poggendorff who died on February 7th, 1981. Dr. D.J. McDonald, MSc.Agr., Ph.D., Regional Director of Agriculture, Orange, N.S.W., was chosen as the speaker on account of his long-standing professional association with Walter Poggendorff.

Dr. McDonald's main research work has been in the field of rice. He was a rice-breeder and research agronomist at Yanco and later the Regional Director of Research there, before becoming Regional Director of Agriculture for the Central West, South-East and Illawarra regions, based at Orange. After initiating the current rice-breeding program in N.S.W., he bred Australia's first long-grain rice variety, called Kulu. He also pioneered the use of aerial seeding techniques for rice in N.S.W. His wide experience was used in Bangladesh, Burma and China to help their agricultural programs. It is no surprise that Dr. McDonald was awarded the Farrer Memorial Medal for Distinguished Service to Australian Agriculture.

INTRODUCTION

Walter Hans Poggendorff was Chief, Division of Plant Industry in the New South Wales Department of Agriculture when I first met him in 1957. He was visiting Leeton Experiment Farm on one of his regular country visits to see "whatever might be of interest".

Having been appointed as a Research Agronomist (Pastures) only a few weeks before, I found his personal interest in my initial experiment very encouraging. His suggestion that I consider taking up the job of Rice Breeder/Agronomist at Yanco, shortly to be vacated when Tom Lawler resigned to go north, took me completely by surprise! However, in April of that year I went to Yanco Experiment Farm to assist with the harvest of rice plots. So began my career in rice breeding and research which was to bring me into close contact with Walter Poggendorff for the next 10 years.

“Pogg”, as most of his friends affectionately know him, took great interest in the rice research program until he retired in 1968. It was his conviction about the need for adapted long grain varieties of rice that stimulated me to try my hand at breeding them. His knowledge of the crop, and perspectives born of his own encounters with it, are lasting impressions for me. He never failed to spend time with me on his country visits, especially during those early years, and rarely arrived without some snippet of new information or a fresh suggestion about the work.

Though he concentrated on rice, Walter Poggendorff was no stranger to an awesome range of other crops that came within his breeding portfolio. He told me that the advice given to him in Head Office as he was leaving to take up his position of Assistant Plant Breeder at Yanco was to “go and cross up everything you can lay your hands on”, advice which he took to heart. Few plant breeders could lay claim to having contributed in such widely diverse species as rice, peaches, apricots, grapes and rock melons.

Plant breeding as a science was still in its infancy when he began his work in 1928. Looking back from our present position, less than 60 years down the track, the implications of his statement that “Only one variety of rice, of the many thousands in existence, is known to have been deliberately bred by man....” (Poggendorff, 1937) is difficult to comprehend. Walter Poggendorff literally was a pioneer in Australian plant breeding.

RICE BREEDING AND RESEARCH

The rice industry to which he came as Assistant Plant Breeder in 1928 was a turbulent youngster. In 1925, during the first year of commercial cropping, the Murrumbidgee Irrigation Area Ricegrowers’ Society was formed. Within a year this Society had persuaded government to impose a protective duty on imported rice. They fought bitterly to have the Irrigation Commission liens over crops removed and in 1928 successfully petitioned for establishment of a Rice Marketing Board. At the same time, co-operation on the technical front was widened with grower representatives being added to the Rice Investigations Committee (I.R.E.C., 1955).

Poggendorff’s assignment was “to undertake the task of providing pure seed stocks of the varieties in demand, and effecting any improvement possible in the yield, quality or type of rice” (Anon., 1937).

Seed Certification

Only a few varieties had been tested by growers and seed of those cultivated commercially in 1928 had become badly mixed (Wenholz, 1928).

After his first season as Assistant Rice Breeder, Poggendorff was able to report that he had started pure-lining the two varieties of most interest, Galore and Colusa. He had already noted (report to the Director of Plant Breeding, June 1928) the range of promising variants in Galore including “...a few very good yielders...”. A third variety, Wataribune, from which Caloro had been selected in California, does not seem to have been included in the program for long. Ultimately, it was discarded by growers because of its very late maturity and heavy awn (Anon., 1937).

He also reported that a very significant part of the pure seed problem was due to inability of growers to distinguish between seed of different varieties which they sometimes mixed. His first published paper in the Agricultural Gazette was a detailed description of Galore and Colusa aimed at rectifying this problem (Poggendorff, 1928).

Twelve tons of the first pure strain of Galore, named Caloro II, were distributed in 1932. A year later two tons of another pure strain, named Late Caloro, were released on trial. Despite its late maturity the latter gained instant popularity because of its high yield and better grain quality. By 1936/37 these two strains were estimated to occupy 30% of the total area of rice and the demand for seed supplies could not be met (Poggendorff, 1937).

Purifying the earlier maturing variety, Colusa, proved a much more difficult task. Red rice contamination was eliminated quite quickly but, on three successive occasions, bulk seed plots were rejected because of the reappearance of offtypes. A relatively high degree of natural crossing over much greater distances than anticipated was found to be the reason. Pure seed of the variety was finally released in 1935 as Colusa 180 together with another very early Colusa Selection 146-1, though neither gained much popularity.

By 1936 the problem of seed purity had been resolved and Poggendorff was able to report

“Thus far, a complete series of varieties, late, midseason, early and very early, all of the same short-grain type, has been produced for commercial culture.... With the entry of the last into the continuous pure seed production scheme evolved, the first objective of the improvement programme commenced in 1928 may be considered achieved” (Anon., 1937).

Experiment on Natural Crossing

In the course of his selection work, Poggendorff realised that, if natural crossing occurred between varieties some distance apart, there were serious consequences for the design of pure seed layouts. Using a unique “circle” design which he devised for the purpose, he established that natural crossing was reduced to 0.06% when varieties were separated by 10 feet (Wenholz, 1936).

This experiment, though similar in concept to earlier ones conducted in the U.S.A., was a mark of Poggendorff's ability to improvise. The results were apparently not published in detail but they were certainly taken into account in the pure seed program where “The results obtained led to a complete reorganisation of stud plot methods” (Anon., 1937).

Dwarf Strains of Caloro

Buried amongst his comments on improved strains of Galore and Colusa is an intriguing observation

“Among the interesting curiosities which have been discovered during the course of this selection work, are two “mutations” in Galore, both dwarfs, but completely fertile.”
(Poggendorff, 1937).

One wonders what the outcome might have been had Poggendorff taken these “curiosities” seriously enough to persevere with them as potential varieties. Perhaps he did but I can find no further specific reference to them. Little did he realise that just such dwarf phenotypes would one day revolutionise concepts of high yielding plant type. It is likely of course that, without

chemical weed control, accurate land levelling, and high rates of fertiliser, the dwarfs would have performed comparatively poorly.

Variety Improvement

While the first priority of the time was to lay the foundation for pure seed production of Galore and Colusa, Poggendorff very quickly became interested in other areas of variety improvement. In particular he saw the need to do something about straw strength and quality (milling and cooking quality) of the varieties grown.

Introduction of Foreign Varieties

From the outset, local millers and processors were asking for higher quality grains than the Californian types like Galore and Colusa. Varieties were introduced from all sectors of the rice-growing world in an attempt to find the desired types. Unfortunately, those originating in tropical countries generally were far too late maturing to be of any direct interest. Others from China, Spain, Italy and Japan were very much like the standard varieties already grown. However, the American varieties included some medium and long-grained rices which, though all later maturing than Caloro, appeared to have possibilities (Wenholz, 1931). A few impressed Poggendorff with their quality and/or straw strength, notably Lady Wright and Texas Patna. Others such as Blue Rose and Edith followed in later years and were “acclimatised”.

A most interesting feature of Poggendorff's reports on these introduced varieties was his quite frequent reference to their “progressive adaptation”. His observations led him to assert that “The time taken to reach maturity often diminishes, comparatively rapidly at first, then more slowly, and in some cases a certain amount of minor “breaking up” occurs in apparently pure varieties, probably due to actual “non-fixity of the varieties’ reactions to new light and temperature conditions” (Poggendorff, 1937). The “acclimatisation” of some U.S. varieties, such as Ediths and Blue Rose, which had special attractions from a quality point of view, is specifically mentioned.

In later years we discussed this phenomenon many times and I think it is fair to say that he was unwilling to rule out the possibility of genetic adaptation.

Intervarietal Crossing

With the pure seed program well established, Poggendorff set about trying to make crosses between the best of the high quality introductions with the adapted varieties. His belief was that

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“In artificial crossbreeding undoubtedly lies the greatest hope of further rice improvement, and one which has as yet been barely touched” (Poggendorff, 1937).

Making crosses proved extremely difficult under the hot dry conditions and only succeeded in doing so after a detailed study of flowering and pollination (Poggendorff, 1932). He devised his own method which relied upon choosing dull, cloudy days when flowers would open before anthers dehisced. Fresh pollen was obtained by floating heads of the donor parent on the water where higher temperature and high humidity caused flowers to mature and open (Poggendorff, 1933).

Wenholz reported excitedly in 1932 that –

“A few grains have been developed from crosses of Caloro with Blue Rose and Lady Wright, and it is expected that this modest beginning will be an epoch-making stage in the improvement of Australian rice”.

The American varieties were said to be so superior in grain quality, and to command such an advantage in price on the export market, that the combination of such quality with early maturity by crossbreeding was “clearly indicated as an urgent need in the improvement of Australian varieties”.

As good fortune would have it, one of these crosses, Lady Wright x Caloro did produce progeny with good potential. In his report to the Director of Plant Breeding in 1935, Poggendorff described one of these, Lady Wright Crossbred 13-3-1, as follows:

“Large medium type grain like that of Blue Rose, but longer and broader; matures slightly after Caloro II and before Late Caloro and Blue Rose. Decidedly one of the most promising selections of its type yet tried”.

Writing to H.S. Gardiner, Managing Director, Waters Trading Co. Sydney, on 6/5/39 he described Lady Wright Crossbred selections as follows:

“13-3-1 and 13-3-3 are examples of practically complete success in attaining the desired objective – both are excellent yielders, far surpassing any introduced “medium-long” grain variety in this respect, though not quite equal to the best of the short-grains; both have outstanding straw strength, and I think that their appearance and cooking quality are beyond reproach.

13-3-1 could be grown commercially at practically the same price as Caloro; it is unfortunate that there is no better local market for this type than you indicate, even if the export market is closed by competition; every one of many persons who have been given the opportunity of trying a small sample of 13-3-1 cooked has been anxious to obtain more; for instance, the local hotel company would be glad to purchase two tons annually”.

Despite his optimism and unfailing belief that the new varieties had a place in the local industry, they were never to be taken up commercially though testing continued until the mid 1950s. The reason for this is difficult to ascertain. The correspondence makes it clear that rice traders in Australia and Britain generally commented favourably though they seemingly were reluctant to move away from their proven sources of high quality rice, notably Burma.

The selections tested in the 1950s were of rather bold grain appearance. I examined these carefully with Poggendorff who asserted that the more slender character of his original lines had been lost. It proved impossible to recover those original lines from foreign collections though I tried for several years to do so.

Numerous crosses were made in the 1930s in an attempt to combine early maturity, grain quality, straw strength and yield. In his report to the Director of Plant Breeding dated 10/8/39, Poggendorff made the following observations

“Special attention has been directed to the improvement of straw strength and cooking quality of the standard short-grain varieties. It is a rather peculiar fact that the short type of rice grain is almost invariably associated with rather weak straw; the medium and long-grain types vary widely in straw strength, but a few, such as Lady Wright and Edith, possess outstanding strength, again invariably associated with poor yields under local conditions. The problem of breeding a strong-strawed, heavy-yielding short-grain of good quality is further complicated by the strong dominance of the long-grain character in the hybrid progeny. As a result of repeated attempts and long selection, several strong-strawed short-grain types of good quality and promising yield have been isolated; these are of the breeding Lady Wright x Colusa and Lady Wright x Caloro”.

This intention to “improve the quality” of short-grain varieties by making them firmer cooking would later be proved to be a mistaken concept since the soft cooking character of these varieties is preferred by those who normally eat them. The association of short-grain type and high yield with weak-straw and medium/long-grain type with low yield and often strong straw, together with the partial sterility of many progeny of crosses between the different types which he noted (Anon., 1939) would continue to frustrate breeders across the world for many years to come.

The fact that Poggendorff was not successful in breeding a variety of high quality which was taken up by industry, should not reflect badly on him. A letter from Dr. Jenkin W. Jones (Senior Agronomist in Charge, Rice Production and Improvement, U.S. Department of Agriculture) to the Director of Plant Breeding on 1/10/31 makes it clear that he was trying to do the same thing for California. He wrote in part –

“I have been working on development of suitable long and medium-grain rices, for California, during the past five years. We have at the Biggs Station some promising selections from crosses between long- and short-grain varieties, short- and medium-grain varieties, and long- and medium-grain varieties, but none of the selections are fixed well enough to warrant distribution, though a few which are being tested in the nursery look very promising. Within the next five years we expect to have medium- and long-grain varieties that are adapted to conditions in California”.

Sufficient to say that, with all the resources available to him, he was no more successful than Walter Poggendorff. In fact, in the long run, it was my privilege to breed the first commercial long-grained rice variety, Kulu, for southern New South Wales which was released in 1967, more than 30 years later and well in front of California.

The Special Problem of Milling Quality

In his annual report to the Director of Plant Breeding for 1933/34 Poggendorff refers to a serious problem of grain cracking in commercial crops the previous season and gives account of a “varietal study of the trouble”

“It appears that:

1. There is a marked difference in the amount of cracking in different varieties and strains.
2. Long-grained varieties as a class are consistently more subject to cracking than short-grained.
3. In a very general way, lateness of maturity means less cracking – there are some notable exceptions.

The matter appears somewhat complicated, and is difficult to generalise upon, but the evidence is sufficient to indicate the probable importance of taking this factor into consideration in selection”.

The prospect of selecting for resistance to cracking must have been daunting for he comments

“Some form of shelling device that would hull without breaking sound grains would greatly facilitate this work, and quality analyses; hulling each individual grain with the thumb nail or teeth becomes extremely tedious”.

Susceptibility to grain cracking, which resulted in poor milling quality, was to become a key issue in variety development in the future and his sense that it should be taken into account in selection was eminently justified. So serious did the problem become that sample milling equipment was purchased by the Rice Marketing Board to facilitate research (Anon., 1940).

BREEDING FRUIT TREE, VINE AND CUCURBIT SPECIES

As Assistant Plant Breeder at Yanco, Walter Poggendorff was responsible for working not only with rice but also with peaches, apricots, pears, almonds, grapes and rockmelons. It would be impossible within the confines of this paper to fully document his work with these species and, in any case, many of the original reports appear to have been lost or discarded. I have simply attempted to draw out the highlights of his achievements in these areas from 1928 to 1939 and to identify any fruits of his labours that were not matured until years later.

Peaches

The primary objectives of Poggendorff's work with peaches as given in his own report to the Director of Plant Breeding entitled “Peach Improvement Committee – Canning Peach Breeding” dated 29/7/39 were:

1. “The development of earlier and better canning varieties than any available at the time (Leader, Levis, etc.) to help close the existing gap of about a fortnight between the latest maturing canning apricot (Trevatt) and the earliest peaches.
2. The replacement of red-centred maincrop varieties, particularly Pullar's Cling, with clear-centred varieties of equal or better quality and yielding power”.

Work started in 1928 and encompassed crossing, raising seedlings of standard varieties and introduction of new varieties. Nearly 30 crosses were made using varieties readily available with the particular purpose of eliminating the red centre from varieties like Tuscan and Pullar and transmitting the earliness of Leader to some progeny. The idiom to which he worked was –

“one that combined the quality of Golden Queen, the yield and size of Pullars, and the fruiting habit of Goodman’s, had a smooth symmetrical shape, clear-centre and a small pit”.

Hundreds of seedlings of all available canning varieties were raised “both in the hope of obtaining useful new varieties, and to discover by the general behaviour of the seedlings, the probable inherent value of the varieties as parents.”

New varieties were introduced mainly from South Africa, China and the U.S.A. He was particularly impressed by a set of unnamed crossbreds which he obtained from Dr. Wight in California as a result of his visit to the U.S.A. in 1935.

Six of Poggendorff’s crossbred selections, as well as a Transvaal Yellow seedling selection, had been passed by Leeton Cannery authorities at least twice by 1939. In his final report to the Director of Plant Breeding dated 11/7/40 an obviously disappointed plant breeder commented that two of his early crossbred selections of which much had been expected, were likely to be outclassed by some of the Californian material. He went on to say –

“Though these findings are naturally somewhat disappointing, it must be remembered that the Tuscan X Leader hybrids are the first-fruits of the canning peach breeding programme in N.S.W., endeavouring to compete against selected material which is the product of a very much older and very extensive American breeding programme; indeed, considering the circumstances, it is encouraging to note how close to the desired mark the local hybrids have attained.”

The Transvaal Yellow seedling selection was released under the name “Wight” following rigorous field testing and on the recommendation of a Canning Peach Conference convened by the Department of Agriculture in 1946. “Wight” was described as:

“the name given to the Transvaal Yellow seedling raised at Yanco. The variety is yellow-fleshed clingstone, with a clear centre, and has exhibited outstanding field and processing qualities. Wight matures late in the season at approximately the same time as the standard variety, Pullars Cling. It is recommended for general planting on the Murrumbidgee Irrigation Area because of excellent quality for canning” (Anon., 1950).

Two crossbred selections from the Californian material obtained from Dr. Wight were also named and released at the same time.

Despite this recommendation, Wight has not been widely planted and the industry has settled almost exclusively on the variety Golden Queen or its derivatives.

Apricots

Breeding work with apricots was aimed at the production of later maturing varieties than the standard, Trevatt. Such varieties, it was hoped would bridge the gap between the last of the Trevatts and the earliest canning peaches.

Poggendorff made many crosses with this end in mind using both Trevatt and Moorepark as the standard parent. However, his efforts were to end in disappointment since –

“practically all the seedlings which have shown any promise in quantity, size and yield are earlier, or no later, than Trevatt. The progeny of several late seedlings which were selected for crossing for this character, have failed to satisfy in other respects” (Anon., 1939).

In the hope of achieving a range of useful characters, he introduced new varieties from the geographical centres of origin of the apricot but early results were disappointing. Numerous progeny of seed from Morocco, Palestine and Southern Asiatic Russian States, though showing considerable variation, in general lacked quality and size, and were usually very early (Anon., 1939).

Plums and Prunes

Although he is reported to have made a number of crosses between prune varieties, over a period of at least three years, it seems that nothing ever came of them.

His main contribution in plums was to demonstrate over several years that the varieties d’Argen and Robe de Sergeant were practically self-sterile. He further proved that President and Angelina were the best pollinators for d’Argen and that the Giant prune was rather unsatisfactory (Wenholz, 1932).

Pome Fruits

The only perceived need for breeding work to be done with pears was in the Murrumbidgee Irrigation Area where an improved canning variety was required. Poggendorff made crosses with this objective in view but no reports of useful selections from his program could be found (Wenholz, 1934).

As with plums, he conducted extensive pollination studies and identified the best pollinator varieties to be used (Wenholz, 1932).

As an interesting aside to the pollination studies, Poggendorff undertook an investigation of the effect of cross-pollination on colour in pome fruits (Poggendorff, 1930). The need for such an investigation was amply demonstrated by –

“the persistence of a belief among growers that, especially in apples, varieties which are naturally poorly coloured can be improved to some extent in this respect through pollination by well-coloured varieties, and *vice versa*”.

To resolve the issue, he made reciprocal crosses between Granny Smith, a green apple, and seven highly coloured varieties including Delicious and Yates. The results were clearcut –

“not one of these crossbred fruits showed any variation in colour from that of the normally fertilised or self-fertilised female parent, nor was any colour difference observed in the reciprocal crosses, or in crosses between the coloured varieties themselves.

Similar observations have been made with pears”.

Almonds

Almond growers in the Murrumbidgee Irrigation Areas, and elsewhere, complained that some varieties did not crop satisfactorily despite being in good condition. In 1932 Poggendorff set about trying to elucidate the causes of the trouble and identify appropriate solutions. He quickly established that fruit set of all varieties could be increased greatly by pollination with other suitable varieties. Some particular varieties, such as I.X.L., were almost completely self-sterile. (Wenholz, 1936).

He continued pollination studies on almonds for about four years with the ultimate objective of identifying “varieties of greatest commercial value which will interpollinate satisfactorily to ensure the best possible crops”. By 1936 he put forward a tentative list of recommended varieties and pollinators (Anon., 1937).

These studies required very large numbers of cross-pollinations and detailed observations of fruit set. A year after transfer of the program to Wagga Experiment Farm it was reported that “some 22,000 hand pollinations have been made”. The majority were obviously made by Walter Poggendorff.

Grapes

The 1931 annual report of the Director of Plant Breeding advised that “it has been deemed advisable to do some cross-breeding work with grapes with the object of improving on our present varieties” (Wenholz, 1931). Because of the importance of grapes in the Murrumbidgee Irrigation Area, Walter Poggendorff was the obvious person to take on this work.

Primary objectives of the program were to incorporate disease resistance into wine-grape varieties and to improve the standard table variety Ohanez, which had excellent carrying quality but lacked flavour and disease resistance and was an undesirable colour (white). The additional task “of developing a seedless raisin or a larger sultana of better quality” was added shortly afterwards (Wenholz, 1932).

Despite his efforts to incorporate disease resistance from American varieties into local varieties of European origin, Poggendorff met with little success. He considered that the number of seedlings raised from each cross was insufficient to provide a reasonable chance of selecting the complex set of characters required (Anon., 1937). The difficulty lay in emasculating large numbers of grape flowers. Characteristically he found a way around this using “a new technique of emasculation by the use of hot water prior to anthers...”. However, little came of the wine-grape program. Progress with the sultana/raisin project was also blocked by incompatibility of Gordo Blanco with some other varieties.

Work with table grapes proved more promising. Poggendorff crossed Ohanez with several black skinned varieties. Two selections from an Ohanez x Purple Cornichan cross proved promising and one was eventually released under the name “Nyora”. The description of Nyora given by Hedberg (1985) reads

“It is an attractive, early late season grape.

Nyora berries are dark purple, large, long oval and seeded. The berry skin is tough, the pulp is soft and fleshy and the berries have a pleasant vinous flavour. The bunches are large, shouldered conical and well filled to compact. Vines are vigorous and the large, hairless, dark green leaves have shallow lateral sinuses and a narrow petiolar sinus.

Nyora vines are usually cordon trained and spur pruned. Barren shoots are a problem when vines are either spur or cane pruned, causing poor yields in some years. The bunches are very susceptible to bunch dieback and mealy bugs. Nyora grapes look attractive (aided by a heavy bloom), travel well and store for up to 14 weeks”.

Rockmelons

In December, 1929, Poggendorff published a detailed description of rockmelons and casabas which could be grown in the Murrumbidgee Irrigation Area as a guide to growers and seedsmen. (Poggendorff, 1929). He classified them not only on maturity but also on their commercial attractiveness and tolerance of transport on the long haul to capital city markets. This initiative was designed to deal with problems of “wrong nomenclature of varieties on the part of some local seedsmen” and to counteract the practice of “cataloguing delicate greenhouse varieties of English origin which are a complete failure under our field conditions”. (Wenholz, 1932).

Subsequently he undertook a considerable program of breeding and improvement work with both rockmelons and casabas. Disease was a major problem and successive outbreaks of powdery mildew and downy mildew decimated susceptible varieties. A severe epidemic of powdery mildew in 1934 revealed only two resistant lines but the importance of this disease was reduced by the identification of suitable resistant varieties from Dr. Jagger in the U.S.A. (Anon., 1939). Downy mildew continued to be a major problem.

While no reference can be found to the release of any variety arising from his crossing work, it is clear that Poggendorff made a major contribution to the development of rockmelons and casabas by classifying and purifying varieties, and introducing and testing new, good quality varieties resistant to disease (particularly powdery mildew) which allowed the industry to grow.

CONCLUSIONS

Walter Poggendorff was undoubtedly one of Australia’s outstanding plant breeders. That he was able to work successfully with such a wide range of crops, and that his work was invariably of practical benefit to industry, speaks volumes for his intellectual ability, his powers of observation, his great practical skills and, above all, his dedication and energy.

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