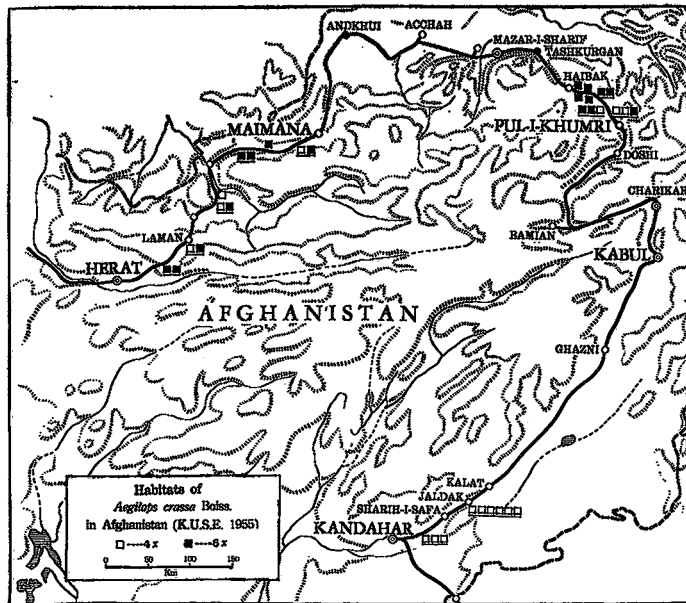


With compliments

WHEAT INFORMATION SERVICE



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CONTENTS

	Page
I. Research Notes:	
Some notes on autotetraploid <i>Triticum monococcum</i>	G. STAUDT.... 1
Linkage analysis by RT-method	K. YAMASHITA.... 3
Once more: "New dates for recent cultivation of Einkorn and Emmer in Jugoslavia"	E. SCHIEMANN.... 3
Induced translocations in wheat	F. C. ELLIOTT.... 4
Awning induced in wheat by treatment with radioactive phosphorus.....	B. P. PAL, M. S. SWAMINATHAN and A. T. NATARAJAN.... 4
Asynaptic effect of chromosome V	M. OKAMOTO.... 6
Identification of the chromosomes of the A and B genomes	M. OKAMOTO.... 7
Bulk and pedigree methods in wheat breeding	L. G. L. COPP.... 7
B chromosomes in <i>Aegilops mutica</i> Boiss.	A. MOCHIZUKI.... 9
Geographical distribution of 4x and 6x forms of <i>Aegilops crassa</i>	H. KIHARA, K. YAMASHITA, M. TANAKA, and S. SAKAMOTO 11
The amphidiploid M ^a M ^b DD and its hybrids with <i>Ae. ventricosa</i>	K. MATSUMOTO, M. SHIMOTSUMA and M. NEZU.... 12
The addition of an <i>Agropyron</i> genome to the common wheat variety Chinese Spring	B. C. JENKINS.... 14
A new amphiploid from a cross between <i>Triticum durum</i> and <i>Agropyron</i> <i>elongatum</i> (2n=14)	B. C. JENKINS and A. MOCHIZUKI.... 15
Self-sterility in autotetraploid rye ..	A. LUNDQUIST.... 15
Frequency of accessory chromosomes in rye strains from Korea ...	A. MÜNTZING.... 16
Polyhaploids of <i>Triticale</i>	E. SÁNCHEZ-MONGE.... 18
II. Genetic Stocks:	
Autopolyploids and amphipolyploids in <i>Triticinae</i> produced at the University of Manitoba to March 1957	M. ROMMEL and B. C. JENKINS.... 20
III. Circulation List of WIS	21
IV. News	22
V. Announcement for the Next Issue No. 6	24
VI. Acknowledgement	24
Explanation of the Figure on the Cover	Cover iii
Committee	Cover iii



I. Research Notes

Some notes on autotetraploid *Triticum monococcum*

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Preliminary investigations were carried out in studying the effect of colchicine treatment on germinated grains of *Triticum monococcum*. Various concentrations of watery colchicine solution were applied for various times. Each group of treatment including 100 grains, the grains were germinated before treatment for 12 hours (Table 1).

Table 1. The effect of colchicine treatment on *Triticum monococcum*¹⁾

Concentration of colchicine solution	Time of treatment in hours					
	3	6	12	24	48	72
0.25%	+	++	++	++		
0.025%		+	+	++	++	
0.0025%		—	—	—	—	—

1) Explanation of signs:

- + Some seedlings showed distinct symptoms of polyploidization. They were delayed in germination as compared with the control.
- No seedling showed any difference from the control.
- ++ The dosage had a lethal effect; all seedlings were killed.

On the basis of these results, 200 grains of *Triticum monococcum* var. *Hornemanni* (T. 482, a variety which is still cultivated in Württemberg, South-West-Germany) were treated in spring 1953 for 6 hours, and 200 grains for 12 hours with a colchicine solution of

Table 2. Chromosome number of seedlings (C_2) of grains from spikes with reduced fertility

Spike No.	Number of grains	Number of germinated grains	Number of seedlings with		
			$2n=14$	$2n=28$	$2n=28 \pm 1$
1 (53, 502/299)	7	7		6	1
2 (")	2	2		2	
3 (")	21	21	6	13	2
4 (53, 506/32)	4	4	4		
5 (53, 501/40)	25	23	23		

0.025%. The seedlings (C_1) were planted in late spring. As doubling of chromosomes usually effects a reduction of fertility, all spikes with reduced seed setting were selected after harvest. All the grains of 5 spikes which showed a distinct reduced fertility were sown in Petri dishes in spring 1954. Before planting these seedlings, the chromosome number was determined in root tips (Table 2).

All the plants of C_3 , descending from plants with $2n=28$ chromosomes had 28 chromosomes, as expected. By selfing a plant of C_2 with $2n=27$ chromosomes 48 grains were obtained. Of these, however, only 11 germinated; they all had $2n=28$ chromosomes.

The tetraploid plants differed from the diploids by their darker green colour of leaves and culms. The extent of tillering and the length of culms are diminished. The density of the spike is significantly reduced. This is the result of the reduced number of spikelets per ear and the increase of the length of spikelets. Development of the tetraploid plants is delayed as compared with the diploids. Earing (the time when the ears are escaped entirely from the upper leaf sheath) takes place in the tetraploid plants in average 2-3 days later than in the diploids. The stage of maturity is reached 4-5 days later than in the diploids (Table 3).

Table 3. Comparison between diploid and tetraploid *Triticum monococcum*¹⁾

	$2n=14$		$2n=28$	
	1954	1955	1954	1955
Number of culms per plant	20.1	5.9	7.9	4.5
Length of the 1st culm in cm	103.9	88.3	69.9	71.5
Density of the 1st ear	40.9	47.5	31.5	32.2
Number of spikelets per ear	32.7	28.1	22.7	23.2
Length of spikelets in mm	11.9		13.5	
Number of days between sowing and earing		105.7		108.3
Number of days between sowing and ripeness of ears		143.7		148.4

1) All differences between the values of $2x$ and $4x$ are significant.

The disturbed meiosis of the tetraploid plants leads to a reduced fertility. The percentage of spikelets with 2 grains is reduced in the tetraploid plants. But there are differences between the years (Table 4).

Table 4. Fertility of diploid and tetraploid *Triticum monococcum*

	$2n=14$	$2n=28$	$2n=27$	$2n=29$
Pollen-fertility (% good pollen grains)	98.3	69.4	1) 35.6 2) 56.8	sterile
Seed-fertility (number of grains per spikelet)	1.01	0.67	1) sterile 2) 0.58	sterile
% spikelets with 2 grains per spikelet				
1954	76.6	17.1		
1955	13.2	12.2		

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Linkage analysis by RT-method

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The main principles of the reciprocal translocation method or RT-method are excerpted from Yamashita (1951) as follows: (1) If a normal plant having a certain gene is crossed with a certain RT-type with known chromosome rearrangement, the hybrids have ④ in F₁ generation and segregate 7_{II} normal: ④: 7_{II} RT-homozygote in a ratio of 1:2:1 in F₂ generation. (2) If the transmission of the gene is linked with the RT chromosome complex, for instance a-b, the gene must be located on either a- or b-chromosome, and if it is free from b-c, then it must be located on a-chromosome. (3) If the transmission of the gene is linked with both a-b and b-c, it must be located on a common chromosome b.

By this method a considerable number of gene locations have been established. The following table shows the tentative results obtained in the 1956 season.

Mutants*	Genetic relation to RT's						Chromosomes located
	a-b	b-c	e-f	c-d	a-c	e-g	
Light green	—	—	—	—	—	—	g
Narrow leaf	—	—	—	—	—	—	d

* Induced by X-rays by S. Matsumura and T. Fujii.

(Received April 15, 1957)

Once more: "New dates for recent cultivation of Einkorn and Emmer in Jugoslavia"

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Dr. Borojevic's note in No. 4 of WIS is a valuable supplement to my paper cited above, as far as concerning the extent and distribution of the two crops mentioned. According to my correspondence with the colleagues in Zagreb (see foot-note in No. 3, p. 1) it seemed evident for me to have got, beside the valuable material, complete informations regarding the places where Einkorn and Emmer are still grown. It will be of interest to follow the slow or quick vanishing of these old cereals from this last refuge in Europe. But the note in No. 4 neither changes nor adds anything in principle to my notes on climate, soil and use in No. 3, p. 2. The manifold types described in my paper, valuable theoretically and for breeding purposes have been transmitted to the Cereal Collections of Vogelsang and Gatersleben.

(Received May 18, 1957)

Induced translocations in wheat

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Studies of the X-ray induced translocation of stem rust resistance from *Agropyron elongatum*, $2n=70$, to common wheat have been extended. There was no obvious segregation for morphological characteristics nor were there appreciable differences in metaphase I associations within or between the X_3 , X_4 , and X_5 generations of the rust-resistant stock grown simultaneously in 1956. Nearly all plants were $2n=42$ although an occasional monosomic plant or one with an isochromosome was found. At least three interchanges were involved in differentiating the karyotype of the rust-resistant stock from the susceptible parent variety *Idaed* as revealed in cytological studies of the F_1 hybrid between the rust-resistant stock and *Idaed*.

Some progress was made during the year in the transfer of bunt resistance from an octoploid involving *A. elongatum* to the susceptible *T. compactum* variety *Elgin* through induced translocation and backcrossing.

Of the octoploid wheats assembled last season the following crossed most readily with those involving *Agropyron elongatum* × common wheat:

Material	Source :
(<i>Triticum Timopheevi</i> × <i>T. orientale</i>) ²	G. D. H. Bell, Cambridge, England
(<i>T. Timopheevi</i> × <i>T. polonicum</i>) ²	G. D. H. Bell, Cambridge, England
(<i>T. Timopheevi</i> × <i>T. durum</i> , Carleton) ²	E. R. Sears, Columbia, Missouri
(<i>Agropyron tricophorum</i> × <i>T. durum</i> , Pentad) ²	See Elliott, F. C., <i>Agron. Jour.</i> 43 : 131-136, 1951.

F_0 seeds of various octoploid combinations have been irradiated in numerous ways and the X_1 hybrids will be studied in the summer of 1957.

(Received May 3, 1957)

Awning induced in wheat by treatment with radioactive phosphorus

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Several rust-resistant varieties of bread wheat evolved at this Institute, like N.P. 797, 798, 799 and 809, do not possess awns. N.P. 809 has resistance to many strains of black,

brown and yellow rusts and has been found to perform well in the entire north-western hilly tract of India. It is somewhat late under the growing conditions in the plains. In order to try to get some early flowering mutants in this variety, N.P. 809 plants grown in pots were treated with radioactive phosphorus in 1955. The treatments were carried out when the plants had reached the flag leaf stage and the dosages used were 12.5, 25.0 and 50.0 microncuries of P^{32} (given in the form of H_3PO_4) per 8 lbs of soil. Seeds from the treated plants were collected and were sown in the field during October, 1956. When the plants commenced flowering in February, 1967, it was found that several of them had fully bearded ear heads. In such plants all the tillers had bearded ear heads. A few plants were half-bearded. The data are given below:—

Dosage	No. of plants studied	No. of awned plants		Percentage of awned plants
		Fully bearded	Half bearded	
12.5 μ c	1,790	11	1	0.67
25.0 μ c	4,630	30	1	0.67
50.0 μ c	10,760	5	0	0.046

The awned plants resembled the normal plants in all the other characters and also came to flower at the same time as the rest. Since normal N.P. 809 plants are slightly tipped, it is presumed that the dominant awn inhibitors B_1 or B_2 present in them have been deleted or altered in the fully-bearded mutants. Reciprocal crosses between the awned mutants and the normal plants have been made and the study of the progenies of these crosses will help to understand the nature of the genetic changes involved. Another point of interest is the lower frequency of awned mutation obtained in the 50 μ c treatment. This is probably due to more drastic cytological changes caused by the high dosage and the consequent abortion of many of the aberrant gametes. In the year of treatment, pollen sterility in the 50 μ c treated plants was on an average 54% and these plants also showed reduced seed setting in comparison with the plants treated with the lower doses.

From the practical point of view, the awned mutants are of great value since awned varieties are preferred by the Indian farmers on the belief that the presence of awns reduces or prevents damage to grains by birds. Hence, a breeding programme employing conventional methods is also in progress at this Institute to introduce the character of awning into the otherwise desirable varieties. Also, such mutations, especially those in which only the loci relating to awn development are affected, would help to evaluate critically the contribution of awns to yield in wheat.

(Received May 1, 1967)

Asynaptic effect of chromosome V

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It is known that chromosome III of the Chinese Spring variety has a marked effect on chromosome pairing, and that chromosome II of the same variety has a similar but less pronounced effect (Sears 1944). The other chromosomes of Chinese Spring have not been suspected of any effect on chromosome pairing.

In the F_1 between plants which were monosomic for a telocentric chromosome V and AADD plants (amphidiploid *T. aegilopoides* × *Ae. squarrosa*), 34-chromosome plants which did not carry the telocentric chromosome showed unexpectedly much better pairing than 35-chromosome plants, as is shown in the following table of data from typical plants :

	No. of PMC's	Average number of							
		univs.	bivalents		tri-valents	quadri-valents	5-valents	6-valents	7-valents
			closed	open					
34-chr. plant	200	8.24	5.07	3.445	.735	.685	.19	.22	.02
35-chr. plant	200	23.82	1.025	4.115	.320	.005	0	0	0

If chromosome V belongs to the A genome (Larson 1953), the 34-chromosome plants would be expected to give more univalents and fewer bivalents than 35-chromosome plants. But the above table shows that the average number of univalents is much less and that of bivalents is much more in 34-chromosome plants than in 35-chromosome plants.

If chromosome V belongs to the B genome, 34-chromosome plants would be expected to give fewer univalents than 35-chromosome plants, and the number of bivalents would remain the same. This very slight increase in the expected frequency of univalents comes nowhere near explaining the observed increase of 15 per cell.

A possible explanation for the above facts is that the telocentric chromosome V and hence chromosome V of Chinese Spring carries a gene or genes for asynapsis. Then it follows that chromosome pairing is good in 34-chromosome plants due to the absence of the asynaptic effect of chromosome V, while 35-chromosome plants show poor chromosome pairing due to the asynaptic effect of the telocentric chromosome V. This asynaptic effect of chromosome V has only been observed in this pentaploid hybrid, where two sets of each of the A and D genomes and one set of the B genome are present.

(Received March 16, 1957)

Identification of the chromosomes of the A and B genomes

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On the basis of genetic analysis of stem solidness, Larson (1953) suggested that chromosomes II, III, IV, V, VI, VII, and XIV of the Chinese Spring variety of *T. aestivum* belong to the A genome. Her distribution lacks cytological evidence, however, except that Matsumura (1952) places the chromosome missing in B type speltoids (chromosome IX) in the B genome.

In order to obtain critical cytological evidence as to which chromosomes belong to the A genome and which to the B, crosses were made of plants carrying one or a pair of telocentric chromosomes of the A and B genomes with AADD plants (amphidiploid *T. aegilopoides* × *Ae. squarrosa*). It was expected that a heteromorphic bivalent would be found at meiosis of the F₁ 35-chromosome plants if the chromosome belonged to the A genome, while it would not be observed if the chromosome belonged to the B genome.

The results thus far obtained suggest that chromosomes V, VI, IX, and XI are in the A genome, and I, VII, and VIII in the B genome. The results are in agreement with Larson's hypothesis, except that chromosome VII and XI are reversed and IX is here indicated to belong to the A genome. Since chromosomes V and IX are in the same homoeologous group, it seems unlikely that both belong to the same genome. Experiments are under way which it is hoped will shed further light on this problem.

Chromosomes III, X, and XII will be tested in the spring of 1957.

(Received March 26, 1957)

Bulk and pedigree methods in wheat breeding

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The author has replied, recently, to a general questionnaire on the comparison of the bulk and pedigree methods of plant breeding sent from the Development Bureau of the Ministry of Agriculture and Forestry, Japan. The information supplied was concerned mainly with wheat breeding and may be of interest to other wheat breeders. The results of 26 years' work in New Zealand in which the two methods have been carried out simultaneously, have shown that the pedigree method is to be preferred under conditions where diseases are not limiting factors.

Using the "pedigree" method, the procedure has been the selection of single plants in F₂ and further selection of single plants in F₃. In the F₄ generation there has been rigid rejection of any of the progenies of the F₃ single plants which showed weaknesses

in any agronomic character, and in F_5 and F_6 , in small yield trials, lines were rejected for low yield or poor baking quality. Very few crosses have had individual progenies which have survived to F_7 or F_8 for the first large field trial.

By the "bulk" method there has been (a) selection of single plants in F_2 followed by eight years without further selection or (b) nine years without selection in F_2 . In F_{10} individual grains were sown at wide spacing ($10 \times 40 \text{ cm}^2$) for selection of single plants. The single plant progenies (L_1 - L_4 generations) were grown in the same way as those obtained by the "pedigree" method with the same rejection for defects. Any progenies which survived were sown in their first large field trial in L_5 (F_{16}).

As the basis for comparison of the two methods the number of crosses is considered from which single plant progenies, selected by either method, were sown in field trials up to 1956. The first hybrid bulk was started in 1930 and all crosses under discussion were made between 1930 and 1941. Selections were made from some crosses by both methods, in others only the pedigree method was used and some crosses were made specifically for bulks. The numbers of crosses made for each purpose follow:—

Single plant progenies selected by pedigree method.....	111
Selected by pedigree and bulk methods.....	108
Selected only by bulk method	37
F_1 generation used for compound crosses, only, and those from which no single plants were selected in F_2	132
Total number of crosses made (1930-41)	388

From the 219 crosses used for selection by the pedigree method, 42 crosses (19%) produced 202 progenies which survived for at least one year in large field trials. Of the 145 crosses used for selection by the bulk method, 7 crosses (5%) produced 34 progenies which were grown in field trials. The average numbers of progenies per cross were 4.8 and 4.9 respectively. Five named varieties were obtained by the pedigree method, Fife Tuscan, Yelder, Hilgendorf, Arawa and Aotea. There were no named varieties produced by the bulk method of breeding.

A further comparison is obtained from the 108 crosses from which material was grown for selection by both the pedigree and the bulk method. The latest generation by which all progenies from an individual cross were rejected was for (a): the number of crosses from which selections were taken by both methods and (b): the number of crosses from which selections were taken by the pedigree method only, the material grown for the bulk method being rejected before reaching the F_{10} generation.

	Pedigree							Bulk						
	F_3	F_4	F_5	F_6	F_7	F_8	V*	Total	L_1	L_2	L_3	L_4	L_5	Total
(a)	1	1	2	8	8	12	3	35	3	7	10	11	4	35
(b)	6	7	13	22	17	7	1	73						

* Named varieties obtained.

For example, there were 22 crosses in which no selections were obtained from the bulk line, and in which some selections by the pedigree method survived up to F_6 but were rejected by F_7 .

Material from crosses made after 1941 is still under test. The total number of crosses made between 1927 and 1956 was 754 (many crosses were repeated several times) and the total number of hybrid bulks started was 269.

Two high yielding varieties, recently released, have been bred by the pedigree method:—

Arawa: The average percentage increase over the standard variety was 17%, in 61 large replicated field trials, sown in different districts, over 6 seasons.

Aotea: The average percentage increase over the standard variety was 22%, in 85 large replicated field trials, sown in different districts, over 8 seasons.

The immediate effect of these varieties on the breeding programme has been the raising of the yield standard for wheat trials and the rejection of the majority of the progenies in the various stages of testing. For this reason the hybrid bulk method has been abandoned for general wheat breeding as it does not keep pace with the production of new high yielding varieties in various parts of the world. Selection by the pedigree method from crosses with these new wheats as parents may result in further increases in yield which will be achieved more rapidly than by the hybrid bulk method.

Compound crosses. The use of F_1 generations as parents for further crosses widens considerably the variation expected in F_2 and allows for the selection of combinations of the attributes of four or more parents. Frankel in 1936, made his first compound cross which involved four distinct varieties. This practice, the use of F_1 generations as parents for further crosses, was continued at the Wheat Research Institute and later at the Crop Research Division to which wheat breeding was transferred. The two new wheats, which have produced large increases in yield, were both derived from compound crosses.

(Received May 11, 1957)

B chromosomes in *Aegilops mutica* Boiss.

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In 1956 a small closed bivalent in addition to the normal chromosomes was observed in meiotic metaphase of an F_1 plant obtained from a cross between *T. Timopheevi* and *Ae. mutica*. A similar association was later observed in the F_1 's of *Ae. bicornis* × *Ae. mutica* and *Ae. sharonensis* × *Ae. mutica*. The bivalent association was readily distinguishable from normal chromosomes. Somatic chromosome counts of all three F_1 's revealed

two more than the expected number¹⁾. Only one *mutica* plant²⁾ which had been clonally increased was used in these crosses. This evidence suggests that the supernumerary chromosomes could be attributed to the *mutica* plant used as a pollen parent.

A check of 18 offsprings raised from the original *mutica* plant showed that 6 had one B chromosome and 12 had three B chromosomes in addition to the 14 chromosomes in somatic cells. The B chromosomes have a median centromere and are shorter than the smallest chromosomes of *Ae. mutica*. Their staining reaction to acetocarmine and leuco-basic fuchsin was the same as for ordinary chromosomes and there was no variation among the B chromosomes for size or staining reaction. However, it was frequently seen that the number of B chromosomes varies in different parts of the same plant. Usually B chromosomes were found in stem tissues, the integuments and anthers but not in the root tips of the same plant. Even in plants with a B chromosome the proportion of cells with or without the B chromosome in the root tips is quite variable (Table 1).

Table 1. The frequency of cells with and without B chromosomes in root tips of one-B plants

Material No.	No. of cells with B	No. of cells without B	Total
2 Root tip -1	20	117	137
4 Root tip -1	0	35	35
Root tip -2	0	35	35
Root tip -3	3	86	89
6 Root tip -1	42	206	248
Root tip -2	42	107	149
Root tip -3	4	85	89

In contrast to this, no B chromosomes could be found in the root tips of a plant known to have three B chromosomes even in a very young root tip approximately 2 mm long coming from a new tiller. This occurrence requires further investigation for an explanation.

In all plants examined to date, meiosis is abnormal when one B chromosome is present. There is no pairing at first metaphase and all the univalents are distributed to the poles, apparently at random. The next division is equational. In contrast to this meiosis is reasonably normal when three B chromosomes are present. The most frequent figure at first metaphase is 7 bivalents and 1 trivalent. When univalents are observed there is always an even number indicating that the trivalent does not become 3 univalents or a bivalent and 1 univalent. The trivalent, presumably made up of the 3 extra chromosomes, forms a V or O configuration and thus must be made up of closely homologous chromosomes. At anaphase the distribution is 8 to one pole and 9 to the

1) F₁ plants of *Ae. umbellulata* × *Ae. mutica* died at the young stage but the two extra chromosomes were observed in root tips.

2) The writer is grateful to Dr. R. C. McGinnis, Laboratory of Cereal Breeding, Canada Department of Agriculture, Winnipeg, Manitoba, who kindly supplied this original plant.

other with no laggards in either the first or second divisions. However, in pollen mitosis non-disjunction of the B chromosome takes place in the first division and both its halves are included in one daughter nucleus.

Since to the writer's knowledge there has been no report of B chromosomes in the genus *Aegilops*, it would be much appreciated if readers of this article having seed samples of *Ae. mutica* could share them so that a more complete survey could be made on samples from several sources.

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Geographical distribution of 4x and 6x forms of *Aegilops crassa*

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Aegilops crassa is known to be distributed through Palestine, Syria, Iraq, Iran, Afghanistan and Turkestan (Eig 1929), but the respective geographical distribution of the 4x and 6x forms have not been established as yet. In our stock, however, 1 strain from Iraq revealed to be 4x, while 1 from Tashkent (Turkestan in U. S. S. R.) was 6x.

As reported previously (see WIS No. 4, pages 19-20), H. Kihara and K. Yamashita joined the Kyoto University Scientific Expedition to the Karakoram-Hindukush in 1955 and they collected a considerable number of *Aegilops* in Afghanistan and Iran. Those materials have been grown in the experimental fields at Kyoto (Kihara Institute for Biological Research) and Misima (National Institute of Genetics) in 1956 and studied morphologically and cytologically. It was found that all the strains of *Ae. crassa* from Iran are 4x, while in Pulikhumri and Maimana (Afghanistan) 6x forms grew mixed together with the 4x (see Table 1 and the sketch-map on the cover).

Table 1. *Aegilops crassa* collected in Afghanistan and Iran (K. U. S. E. 1955)

Regions	Habitats	Strains	4x	6x
Afghanistan:				
Kabul	2	9	9	9
Pulikhumri	7	12	2	10
Maimana	7	11	8	4
Iran:				
Meshed	1	1	1*	0
Tehran	1	4	4	0
Tabriz	10	10	10	0

* Based on morphological analysis.

There are significant ecological and morphological differences between Afghan and Iranian strains: the Iranian group is recumbent and has narrow and dark green leaves, while Afghan strains are erect and have broad and light green leaves. In Kandahar, a city in the southern province of Afghanistan where no 6x was found, a new awnless 4x form was collected.

From the fact that the 6x forms of *Ae. crassa* have been found mixed with 4x in the northern stretch of the Hindukush Range, it can be said that the 6x form originated there from a cross between 4x *crassa* and a 2x *Aegilops* species. The latter could have been *Aegilops squarrosa* which grows widely in those areas.

Based on genome analysis, the genome constitution of 4x *crassa* is DM^{cr} and that of 6x DM^{cr} (?). If the above mentioned assumption is right, the unknown genome of 6x *crassa* should be D from *Aegilops squarrosa*. M. Tanaka obtained an amphidiploid from 4x *crassa* × *Ae. squarrosa* which is morphologically identical with 6x *crassa*.

(Received May 1, 1957)

The amphidiploid M^wM^wDD and its hybrids with *Aegilops ventricosa*

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In 1942 Matsumoto and Kondo have reported on amphidiploids from the hybrid *Ae. squarrosa* (DD) × *Ae. uniaristata* (M^wM^w) and its reciprocal. These amphidiploids were lost during the war time. We have succeeded in producing an amphidiploid M^wM^wDD again in 1954 from the same combination, *Ae. uniaristata* × *Ae. squarrosa*, by colchicine method.

The chromosome pairing, percentage of pollen- and seed-fertility of the amphidiploid (M^wM^wDD) are given in Table 1.

Table 1. Chromosome pairing and fertility of the amphidiploid M^wM^wDD

Bivalents	Univalents	Complexes	Fertility in %		
			Pollen	Seed	
				Self	Free
9-14 (14)	0-4 (4)	0-2 _{III, IV}	63.56	36.2	60.0

The morphology of the amphidiploid (M^wM^wDD) is fairly similar to that of *Ae. ventricosa*. Reciprocal crosses with *Ae. ventricosa* were made for testing the chromosome homology (Table 2).

Table 2. Chromosome pairing and fertility of the hybrids between the amphidiploid M^aM^aDD and *Ae. ventricosa*

Combinations	Bivalents	Univalents	Complexes	Fertility (%)		
				Pollen	Seed	
					Self	Free
M ^a M ^a DD × <i>Ae. ventricosa</i>	5-14 (12)	0-7 (0)	0-3 _{III, IV}	4.05	0.00	3.40
<i>Ae. ventricosa</i> × M ^a M ^a DD	5-14 (12)	0-7 (0)	0-2 _{III} 0-3 _{IV}	8.31	0.00	4.80

5-14 (mode 12) bivalents were observed, and among them 2-5 were strongly associated. Complexes were found in many PMC's. The pollen-fertility was very low and no seed was obtained by selfing, while a few seeds were obtained by open pollination (approximately 4%).

Morphological comparison between the amphidiploid and *Ae. ventricosa* is given in Table 3.

Table 3. Morphological comparison of *Ae. uniaristata*, *Ae. squarrosa*, *Ae. ventricosa*, amphidiploid M^aM^aDD, M^aM^aDD × *Ae. ventricosa* and its reciprocal

Combinations	No. of spikelets	Length of spikes (cm)	No. of sterile spikelets	Index of empty glume (%)	Heading date	Flowering date
<i>Ae. uniaristata</i>	3-5	4.5	0-1	60	6/V	6/V
<i>Ae. squarrosa</i>	9-11	8.7	0-2	50	13/V	13/V
<i>Ae. ventricosa</i>	7-11	10.2	0-1	70	14/V	14/V
M ^a M ^a DD (amphidiploid)	4-7	6.8	2-4	70	30/V	1/IV
M ^a M ^a DD × <i>Ae. ventricosa</i>	6-10	9.9	1-3	70	14/V	15/V
<i>Ae. ventricosa</i> × M ^a M ^a DD	6-10	10.0	1-2	70	14/V	14/V

In 1949 Kihara concluded from a karyological investigation of the hybrid *Ae. triaristata* × *Ae. columnaris* that the genome M^a of *triaristata* is very similar to the *columnaris* genome M^a.

From karyological and morphological points of view, it is concluded that the amphidiploid M^aM^aDD mostly resembles *Ae. ventricosa*.

(Received April 10, 1957)

The addition of an *Agropyron* genome to the common wheat variety Chinese Spring

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In 1938 Professor L. H. Shebeski, now head of the Division of Plant Science, University of Manitoba, pollinated plants of Chinese Spring wheat with pollen from *Agropyron elongatum* (Host) Beauv., $2n=70$. During the following season plants of Chinese Spring were pollinated with the pollen from F_1 's of the cross mentioned above. There followed a series of open and self pollinations among the backcrossed derivatives and eventually highly self fertile lines were established which were wheat-like in appearance but perennial in growth habit, particularly when grown in the greenhouse. In 1949 the writer obtained four of these lines, three of which were designated P. W. 266, 276 and 292 marked F_9 from the cross Chinese \times (Chinese \times *Agropyron elongatum*). A fourth line designated P. W. 327 was in F_{10} of the same cross. These four lines together with a fifth designated P. W. 588-2 have been grown almost every year and are thus at least in F_{15} at the time of writing. Professor Shebeski has made a world wide distribution of this material and it is highly probable that many of the readers will already have descendants of this cross.

While there is still some slight chromosome irregularity which accounts for the variation between plants despite the advanced generation, most plants have a somatic chromosome number of 56. In crosses with common wheat, the most frequent chromosome configuration is 21 bivalents and 7 univalents. This would indicate that a genome from *Agropyron* has been added to wheat. These 56 chromosome plants are similar to those obtained by Sears in a different way¹⁾ with the exception that he added the *Haynaldia villosa* genome instead of a genome from *Agropyron*. Attempts are now being made to add the *Agropyron* chromosomes singly to the common wheat varieties Chinese Spring and Kharkov with the view to eventually developing substitution lines involving the more desirable *Agropyron* chromosomes.

(Received April 18, 1957)

1) Sears, E. R. 1953. Addition of the genome of *Haynaldia villosa* to *Triticum aestivum*. Am. J. Botany 40: 168-173.

**A new amphiploid from a cross between
Triticum durum and *Agropyron elongatum* ($2n=14$)**

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Winnipeg, Manitoba, Canada

The senior author successfully crossed *Triticum durum* variety Stewart with *Agropyron elongatum* ($2n=14$) in the greenhouse late in 1955. The badly shrivelled grains obtained were planted on nutrient medium (Difco Orchid Agar) and four plants were established. Two of the plants were treated with colchicine and two were left untreated. A colchicine treated plant and an untreated plant were transplanted to the field while the remaining two plants were left to grow in the greenhouse during the summer of 1956. All four plants produced seeds in an unexpected high frequency. Cytological observation indicated that non-reduction was permitting the development of pollen grains with 21 chromosomes, consequently natural doubling was taking place resulting in the formation of a new hexaploid from the cross.

Extensive cytological observations indicate that on the average 2.6 bivalents were formed at first metaphase in F_1 plants and unreduced PMC's were observed mixed with normal dyad cells. Offspring with somatic chromosome numbers of 42, 41 and 40 were obtained from these F_1 plants but the majority had 42 chromosomes. In backcrosses with the *durum* parent, plants having 35 and 34 chromosomes were obtained. The fertility in all of these plants is unexpectedly high. Despite considerable variation in chromosome pairing some of the plants show fairly regular pairing of 21 bivalents and these will be selected to maintain the new amphiploid. Attempts are being made to establish a series of addition lines, and also to determine the genome homology of the *Agropyron* chromosomes. It is suggested that this *Agropyron* genome be called E despite the fact that this letter has already been used to designate a genome of polyploid *Agropyron* species as well as for the genome of rye.

(Received April 18, 1957)

Self-sterility in autotetraploid rye

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Self- and cross-incompatibility reactions of the pollen in diploid rye are controlled gametophytically by two apparently multiallelic and independently segregating loci. Haploid pollen with only one of its two factors common to the style has no functional disadvantage, and the incompatibility specificities must be considered to result from a

direct complementary cooperation between the two loci.

Upon chromosomal doubling self-incompatibility is retained in rye. Among 974 plants studied by the present writer and obtained from elite populations of the tetraploid strain of Steel-rye, a Swedish commercial variety, no completely self-compatible plant was obtained, 80-85% of the plants setting 0-5% seed upon selfing. Self-incompatibility is, thus, quite pronounced in the tetraploid strain, but the tetraploids upon selfing set slightly but significantly more seed than do the diploids. Between populations of different years the tetraploids display a considerably higher variability in seed setting upon selfing.

In the S_1 generation obtained from population plants with less than 5% seed setting upon selfing, plants highly fertile upon selfing are obtained—but much more rarely in the tetraploids. In most cases this high fertility upon selfing is retained in later S generations. Such plants may result in the diploids from a loss mutation at the pollen controlling part of an incompatibility locus. In the tetraploids the true nature of such highly fertile plants has not been settled, but in any case tetraploid truly self-compatible mutants must be considered much rarer.

Data from intercrosses between known doubled genotypes show that two homologous alleles of the diploid pollen common to the style, will not be able alone to render the pollen incompatible. Upon intercrosses in four tetraploid S_1 families, obtained from selfed elite population plants of unknown genotype, an ununiform reaction pattern within groups of reciprocally incompatible plants, was frequently encountered. The combined evidence points to the view that in the diploid pollen the single incompatibility locus is not able alone to produce inhibition of pollen tube growth. The pollen specificities result from cooperation between the two loci within pairs of factors. One such factorial pair of the pollen common to the style is sufficient to render the pollen incompatible.

The lower frequency of self-compatible mutants obtained after selfing in the tetraploids can thus be easily understood. In a haploid pollen, containing a mutated "self-compatibility" factor, cooperation between matched, not identical incompatibility factors will no longer be possible; but correspondingly in a diploid pollen several ways of such factorial cooperation may be left possible. A "self-compatibility" mutant factor will accordingly behave in a "recessive" way in the diploid pollen and in a "dominant" way in the haploid pollen.

(Received April 17, 1957)

Frequency of accessory chromosomes in rye strains from Korea

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Though the typical chromosome number of rye, *Secale cereale*, is $2n=14$, individuals with additional accessory chromosomes of a specific type are known to occur in rye

populations from various parts of the world. When such chromosomes are present their number is generally two or more rarely four, plants with uneven numbers (one or three) being quite rare. This preponderance of even numbers of accessory chromosomes is caused by the occurrence of a process of directed non-disjunction, occurring at the first pollen mitosis and at the corresponding stage on the female side.

Some commercial varieties of rye seem to be quite devoid of plants with accessory chromosomes, and in other varieties they may be present in low frequencies. In more primitive strains of rye from Turkey, Afghanistan, and Iran accessory chromosomes are, on an average, more frequent, though also in these regions populations may occur which entirely lack such extra chromosomes.

In a primitive summer rye strain from Transbaikal the percentage of plants with accessories was found to be as high as 28. However, there are other regions in the Far East, in which such chromosomes are still more frequent. The work of Oinuma (1952) indicated a high frequency of accessories in rye from Korea, and this has now been verified, as may be seen from Table 1. The seven strains examined were raised from seed material most kindly put to my disposal by Dr. Chang Choon Woo of the National Institute of Horticulture, Pusan, Korea.

Table 1. Number of accessory chromosomes in seven strains of rye from Korea

Field number	Place of origin	Number of acc. chrs.					%	Percentage of plants with acc. chromosomes	Average number of acc. chrs. per plant
		0	1	2	3	4			
030	Seoul No. 1	17	—	9			26	34.6	0.69
031	" No. 2	29	1	6			36	19.4	0.36
032	Suwon	7	3	16	1	6	33	78.8	1.88
033	Yonkii	2	2	9	—	6	19	89.5	2.32
034	Booyou	4	—	34	2	7	47	91.5	2.17
035	Kongjoo	25	1	14	1	3	44	43.2	1.00
036	Kyongsang-namdo	19	1	4			24	20.8	0.38

The results of the chromosome counts are, indeed, interesting, the average frequency of accessory chromosomes being much higher than in any other geographical region so far studied. This is especially true of the populations from Yonkii and Booyen, in which the average percentages of plants with accessory chromosomes were as high as 89.5 and 91.5 per cent respectively. The frequencies in question are significantly different in different populations, the lowest value, 19.4 per cent, being found in No. 031 (Seoul No. 2).

The accessory chromosomes listed in the table are all of the standard type. In a few plants structurally deviating types were also observed. As usual, even numbers of accessories, 2 and 4, are predominant.

So far the surprisingly high concentration of accessory rye chromosomes in Korea is just a puzzling fact, and we do not know if this concentration is correlated with

special climatic and edaphic conditions in this part of the world, or if it is only a consequence of historic factors during the distribution of the species *Secale cereale*. Under such circumstances a thorough study of the rye populations in Korea and adjoining countries is, indeed, urgent. In the meantime investigations of the genetical and cytological effects of the accessory chromosomes in the populations already available may be undertaken. As presence of accessory chromosomes seems to be a primitive trait studies of these chromosomes may be of importance for the problem of the centre or centres of origin of cultivated rye.

(Received April 5, 1957)

Polyhaploids of *Triticale*

E. SÁNCHEZ-MONGE

Estación Experimental de Aula Dei, Zaragoza, Spain

With the purpose of comparing the ecological behaviour of our 42-chromosome *Triticale* with 56-chromosome forms under Spanish conditions, crosses have been carried out between Mediterranean common wheat varieties and rye. From 100 pollinated flowers in one of these cross-combinations, 26 F₁ plants were obtained, of which 20 produced partially fertile ears after colchicine treatment in 1955. The seeds from these plants were sown separately. The severe winter of 1955-1956 eliminated 6 of the 20 plant progenies. Of the 14 progenies coming into maturity an analysis of the fertility is given in Table 1.

Table 1. Fertility of plant progenies of 56-chromosome *Triticale*¹⁾

Progeny No.	Number of plants	Fertility (%) in		
		individual plant (maximum)	individual plant (minimum)	average
57	21	97.1	14.1	69.1
58	59	140.9	44.1	76.5
59	54	97.8	26.1	71.8
60	45	117.7	23.8	73.2
61	3	100.0	91.5	96.3
63	41	93.1	33.0	68.0
65	9	76.4	0.0	44.5
66	21	69.8	17.7	48.7
69	13	81.0	25.4	52.8
70	35	82.6	9.5	52.8
71	14	94.1	40.4	71.6
72	13	85.2	58.8	74.6
73	16	98.6	52.9	71.1
75	8	94.4	60.5	80.8

1) Fertility is measured as the percentage of seeds in relation to flower number. Flower number is taken as the double of spikelet number.

A study of the meiosis in the PMC of several plants of each progeny, fixed at

random, showed that 13 progenies have 56 chromosomes, while progeny No. 65, comprising 9 plants, revealed some deviating chromosome numbers, which compelled us to study more closely all 9 plants. Chromosome counts in the root tips of these plants gave the following results: 5 plants having $2n=56$, 1 plant with $2n=40$ and 3 plants with $2n=28$.

The meiotic behaviour in the PMC of the plants with $2n=28$ is summarized in Table 2.

Table 2. Meiotic associations at MI of the 28-chromosome plants

Univalents	Bivalents	Trivalents	No. of cells
28	0	0	8
26	1	0	31
24	2	0	33
22	3	0	13
20	4	0	3
18	5	0	2
25	0	1	2
23	1	1	1
21	2	1	4
Total			100

The plants with $2n=28$ are obviously polyhaploids having 21 chromosomes of *Triticum aestivum* and 7 of *Secale cereale*.

Polyhaploids derived from artificial amphidiploids have been reported before (cf. D. Kostoff 1942, *Bibliographia Genetica* 13: 1-148) and are in most cases due to pollination with foreign pollen. But cases have been also reported where haploids have been induced either by delayed pollination or by pollination with irradiated pollen.

As our polyhaploid plants were grown from seeds obtained from a partially fertile ear, lack of pollen or its bad quality may be the cause of their parthenogenetic origin.

(Received March 28, 1957)

II. Genetic Stocks

Autopolyploids and amphipolyploids in *Triticinae* produced at the University of Manitoba to March 1957

M. ROMMEL and B. C. JENKINS

Division of Plant Science, University of Manitoba
Winnipeg, Manitoba, Canada

Variety or cross	Accession number ¹⁾	Growth habit ²⁾
Autopolyploids		
<i>Aegilops squarrosa</i>	56 C 4. 22	W
<i>Aegilops bicornis</i>	56 C 4. 23	W
<i>Aegilops sharonensis</i>	56 C 4. 24	W
<i>Aegilops longissima</i>	56 C 4. 25	W
<i>Secale cereale</i> (Dakold, self fertile)	56 D 4. 8	W
<i>Agropyron elongatum</i> (2n=14)	56 E 4. 57	W
<i>Agropyron triticeum</i>	56 E 4. 58	S
Amphipolyploids		
<i>T. aestivum</i> (Minhardi) × <i>S. cereale</i> (Dakold)	56 G 8. 21	W
" (Jones Fife) × " "	56 G 8. 22	W
" (Yogo) × " "	56 G 8. 23	W
" (Prelude) × " (P. I. 178530)	56 G 8. 24	S
" " × " (P. I. 205221)	56 G 8. 25	S
" (Onas 53) × " (French)	56 G 8. 26	S
" (Karn II) × <i>Ae. variabilis</i>	56 A 10. 20	S
<i>T. durum</i> (Stewart) × <i>A. elongatum</i> (2n=14)	56 A 6. 21	S
<i>T. aestivum</i> (Norin 10) × <i>S. cereale</i> (Dakold, self fertile)	57 G 8. 6	W
" (Chinese Spring) × <i>S. cereale</i> (Dakold, self fertile)	57 G 8. 7	S
" (Kharkov M. C. 22) × <i>S. cereale</i> (Dakold, self fertile)	57 G 8. 8	W
" (Kharkov M. C. 22) × <i>S. montanum</i>	57 G 8. 9	W
<i>T. turgidum</i> var. <i>speciosissimum</i> × <i>S. dalmaticum</i>	57 G 6. 16	W
P. W. ³⁾ 327-4 × <i>S. montanum</i>	57 A 10. 1	W
P. W. 327-6 × <i>S. cereale</i> (Dakold, self fertile)	57 A 10. 2	W
P. W. 588-2 × <i>S. montanum</i>	57 A 10. 3	W

1) The number preceding the decimal indicates the ploidy: 4=4x, 6=6x etc.

2) S=summer type, W=winter type

3) P. W.=Chinese Spring × (Chinese Spring × *A. elongatum*) F₁₅ 8x

III. Circulation List of WIS

(Addition, May 10, 1957)

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(New Addresses, May 10, 1957)

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IV. News

X International Congress of Genetics

McGill University, Montreal, P.Q., Canada, August 20-27, 1958.

General Organizing Committee—J.W. Boyes, *Chairman and General Secretary*, E.W. Caspari, M. Demerec, P.C. Mangelsdorf, H.B. Newcombe, *Ex-officio*, F.J. Ryan, S.G. Smith and N.F. Walker:

“The X International Congress of Genetics will be held at McGill University, Montreal, Canada, from August 20-27, inclusive, 1958. Congress Committees are now actively preparing for your arrival and raising funds for travel grants, particularly for overseas geneticists.

The programme will include symposia, invited papers, short contributed papers, demonstrations, other meetings and exhibits. There will be a special exhibit on “The Role of Genetics in the Service of Man”. Also, we are preparing an interesting programme for the ladies and children and the latter will be cared for in a “Progeny Park”.

Pre- and post-Congress tours both local and extending through eastern parts of Canada and the United States are being arranged. University residences, hotels, tourist homes or camping facilities can be arranged for members and their families.

Overseas transportation should be arranged very soon as travel accommodation is already being heavily booked for 1958. Family travel plans should be investigated.

If there is any possibility that you will be able to attend, we ask you to write to us according to the information requested below *immediately*.

The Secretary General”

.....
Professor J.W. Boyes
Department of Genetics
McGill University
Montreal 2, P.Q., Canada

Please send me further information regarding the X International Congress of Genetics.

Name :

Address :

.....
.....

Wheat Genetics Symposium

By B.C. Jenkins, Division of Plant Science, Univ. of Manitoba, Winnipeg, Man., Canada:

“I presume it would be satisfactory to announce that plans are being made to hold the first International Wheat Genetics Symposium in Winnipeg during the week prior to the Genetics Congress in Montreal, August 20 to 27, 1958. I am busy trying to organize

the program and make arrangements for this Symposium. More complete details will be sent to interested persons as soon as they become available”.

Cited from Wheat Newsletter, III, 1956:

“At the meetings of the Associate Committee on Plant Breeding in Saskatoon, February 18 to 20, a motion was passed in favor of holding a Symposium on Wheat Genetics in Winnipeg in 1958. Tentative dates are August 13-15, the week prior to the International Genetics Congress to be held in Montreal. Dr. B.C. Jenkins, from the University of Manitoba, was elected general chairman for the symposium. The actual staging of the symposium will depend on a sponsor being found for it, but it is expected that this will be arranged shortly.—*D.R. Knott*”

Wheat Newsletter III.

Wheat Newsletter, Vol. III, edited by Dr. E. G. Heyne, Department of Agronomy, Kansas State College U.S.A., and Dr. D. R. Knott, Department of Field Husbandry, University of Saskatchewan, Canada, has appeared March 1, 1957. Contents: I. Special reports; II. Contributions from Canadian research workers; III. Contributions from U.S. research workers; IV. New varieties; V. Publications and VI. Mailing list. (*K.Y.*)

Robigo No. 3

“Robigo No. 3, cereal rusts news from every body to everybody” appeared in March, 1957. All correspondence concerning this publication may be addressed to: Ing. Agr. Josè Vallega, Institute de Fitotecnica, Castelar, Argentina (cf. WIS No. 4, p. 28). (*K. Y.*)

Kihara's Wheat Monograph

Mr. M. Okamoto, who is now in University of Missouri, Columbia, Mo., U.S.A., has got through with the translation into English of the Japanese edition (1954) of the Kihara's “Studies in Wheat” with the assistance of Dr. E. R. Sears. The manuscripts will be reviewed by the writers of the respective chapters and necessary revisions and additions will be finished by February, 1958.

Contents: Chapter 1. Introduction; Chapter 2. Classification and distribution; Chapter 3. Morphology, particularly of vegetative organs; Chapter 4. Flowering and seed setting; Chapter 5. Gene analysis (I. Morphological characters); Chapter 6. Gene analysis (II. Physiological characters); Chapter 7. Cytogenetics of wheat and its relatives; Chapter 8. a. Natural mutation, b. Artificial mutation; Supplements: List of gene symbols, literatures and index. (*H.K.*)

The 15th Anniversary of The Kihara Institute

Kihara Institute for Biological Research celebrated the 15th anniversary of the founding at the Kanagawa Prefectural Music Hall in Yokohama, May 11, 1957. Dr. H. Kihara,

Dr. K. Oguma and Dr. Y. Sinoto delivered the commemoration lectures which followed by a documentary film entitled "Karakoram" of the Kyoto University Scientific Expedition to the Karakoram-Hindukush in 1955. (K.Y.)

Back Numbers of WIS

Back numbers of WIS, 1, 2, 3 and 4, are available. They will be sent free on application. (K.Y.)

V. Announcement for the Next Issue, No. 6

WIS No. 6 will be ready for publication in October, 1957. It is open to all contributions dealing with informations on methods, materials and stocks, ideas and research notes related to wheat genetics and cytology, including *Triticum*, *Aegilops*, *Agropyron*, *Secale* and *Haynaldia*.

Contributions should be typewritten in English. The authors are cordially requested to present

— not later than October 15, 1957 —

their manuscripts which should not exceed two printed pages. Lists of stocks are not required to conform to this page limit. No illustrations can be accepted for publication.

Manuscripts and communications regarding editorial matters should be addressed to :

Dr. Kosuke Yamashita
Wheat Information Service
Biological Laboratory
Kyoto University, Kyoto, Japan (K. Y.)

VI. Acknowledgement

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We should like to express our sincere gratitude for favorable comments regarding WIS Nos. 1, 2, 3 and 4 and the valuable contributions for the present number. Increased support for further issues would be appreciated.

The Managing Editor

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Explanation of the Figure on the Cover

Habitats of tetra(□)- and hexa(■)-ploid *Aegilops crassa* collected in Afghanistan by H. Kihara and K. Yamashita. Solid line indicates the route of K. U. S. E. 1955 (see page 11).

Information in WIS is to be regarded as tentative and must not be used in any publication without the consent of the respective writers.

WHEAT INFORMATION SERVICE

No. 5

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