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## *Maize in French Agriculture*

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### *I. Introduction*

Between 1750 and 1850 England went through a process of industrialization while much of Western Europe prepared its transition. Yet all over Europe, population grew at a sustained rate that amounted, in the end, to a demographic explosion. Moreover, with the significant exception of the 1845-1847 crisis, the added numbers were fed more consistently, if not always better, than at any recorded time in the past. How was this accomplished? In particular, is there a connection between the ability of European agriculture to feed more people, to sustain if not to call forth the added numbers, and the "agricultural revolution" integral to modern economic growth in most western countries?

The connection cannot be a simple one, as shown by the fact that the growth of population before the mid-XIXth century extended in space far beyond the zones of early industrial development. In a recent article, William Langer has affirmed an alternative explanation.<sup>1</sup> Increases in population were sustained not primarily by

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<sup>1</sup> W. LANGER, *American Foods and Europe's Population Growth*, "Journal of Social History", 1975, number 1, pp. 51-61.

revolutionary changes in agricultural technology but rather by the generalization of two American food crops, the potato and maize, in Europe. Michel Morineau, the debunker of the idea that France experienced agricultural revolution during this period, has also stressed that the potato had no revolutionary role.<sup>2</sup>

The present paper is a study of the other plant emphasized by Langer, maize, in the specific context of the agriculture of southwestern France. It examines the relationships between maize, agricultural progress, and population change in the last pre-industrial, or the proto-industrial, century, and then carries the story forward. Some comparisons are made, using the potato for early periods and agricultural systems, and the sugar beet when dealing with more modern economic and technological contexts.

The argument may be summarized as follows:

- a. Before 1850, maize played some role in sustaining population growth, but as an addition to the old agrarian system rather than an element of revolution. Moreover, maize did little to increase the man/land ceiling as the potato did, by yielding more food to the acre.
- b. By strengthening the traditional system, maize helped postpone more fundamental changes in agricultural technology. Yet far from overcoming the inherent long-run limitations of the system, maize accentuated them.
- c. When a muted Malthusian crisis did hit the French Southwest, it was resolved by gradual but steady depopulation rather than by revolutionary technological change or mass exodus. In the economic eclipse of the region, maize paradoxically regressed even though it often served as an indicator of continued adherence to old ways.
- d. Since World War II, maize has made a vigorous comeback in France, and is now an integral element of modern arable farming in the warmer regions. The spectacular growth of maize cultivation, based on the use of hybrids, extends to the Southwest, but it originated, revealingly, in the areas of most progressive farming technology rather than in the traditional maize stronghold.

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<sup>2</sup> M. MORINEAU, *La pomme de terre au XVIIIe siècle*, "Annales (E.S.C.)", XXV, number 6, Nov.-Dec. 1975, pp. 1767-1785.

Agricultural revolution is treated here as a clearly identifiable set of changes. In fact, the underlying model of evolving agricultural technology is a three-stage one, schematized as follows:

- a. "traditional" agriculture: unable to overcome the fundamental limitation of soil fertility depletion; relying on crop rotations, usually including fallow, to rest the soil; narrowly maximizing the production of food grains, normally wheat and/or rye in the French case.
- b. "revolutionary" agriculture; arable farming integrated with animal husbandry in a virtuous circle; forage and root crops feed more animals and permit adequate soil working and manuring; higher grain yields in turn free land for pasture and fodder crops, further increasing the quantity and quality of animals.
- c. "modern" agriculture: loosening of the interdependencies by means of massive applications of external, purchased, inputs such as machinery and fuels, fertilizers and pesticides, and genetic improvements.

Within each stage, or system, gradual improvement is possible, but the move from one to another involves discontinuity. Innovations that reinforce a given system will be called "defensive". However major they may seem, their impact is inherently bounded. On the other hand, seemingly limited changes can lead the way to a far-reaching transformation denoted by the shift from one stage to another.

In order to understand the place of maize in the agricultural history of the Southwest, it is necessary to bear in mind a few points regarding the region. The lands watered by the Garonne and Adour rivers and their tributaries form a varied ensemble between the Pyrénées and Massif Central. The soils range from rough heath to fertile valley, and the climate modulates, west to east, from Atlantic to Mediterranean. Traditionally, agricultural practice in the region followed the Mediterranean twofold rotation, but this system, suitable in dry areas, made less sense in the fairly well-watered Southwest. There was thus scope for a move to the somewhat

more intensive rotation typical farther north in which land lay fallow one-third, as opposed to one-half, of the time.

In the XVIIIth and XIXth centuries, the Southwest was often spoken of as a comparatively rich region of France, but though the report was often repeated before and since Arthur Young, it was in all likelihood not very accurate.<sup>3</sup> The dominant unit of agricultural production was a moderate-size farm run by a single family unit with occasional, mainly seasonal, use of outside labour. However, although farm size was comparatively uniform, the land was divided between peasant-owned farms and those worked by tenants. The latter, probably in the majority until well along in the XIXth century, in the richer areas at least, were almost invariably let out to sharecroppers (*métayers*). The system of sharecropping combined some insurance against the risks of a variable climate with a sort of perverse insurance against progress and a bias against the intensification of cultivation. In a word, the region relied on its generally favourable natural conditions, the social structure of agriculture being designed only to cope with the one element of risk, irregularities in weather. The Southwest was, in a real sense, underdeveloped.

A major reason for the comparative lack of progress over a number of centuries appears to be the absence of leadership from the cities of the region. The only two of any real consequence, Bordeaux and Toulouse, were both deficient in this regard. Bordeaux, though economically active, was turned toward the sea and otherwise concerned only with the vineyards of the immediate hinterland. Toulouse, on the other hand, the natural capital of the region, remained an administrative centre, its only significant eco-

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<sup>3</sup> For a modern expression, see J. CHOMBART DE LAUWE, *Bretagne et Pays de Garonne*, Paris, 1946, painting a favorable picture in 1840. The strongest critique is that of R. BRUNET, *Les campagnes toulousaines*, Toulouse, 1965, pp. 297-299 and *passim*. Other sources on the traditional rural economy of the Southwest include A. ARMENGAUD, *Les populations de l'Est-Aquitain au début de l'époque contemporaine*, Paris, 1961; P. DEFONTAINES, *Les hommes et leurs travaux dans les pays de la Moyenne Garonne*, Lille, 1932; S. LERAT, *Les pays de l'Adour*, Bordeaux, 1963; P. WOLFF, ed., *Histoire de Toulouse*, Toulouse, 1974; R. FORSTER, *The Nobility of Toulouse in the 18th Century*, Baltimore, 1960; L. DUTIL, *L'état économique du Languedoc à la fin de l'Ancien Régime*, Paris, 1911.

conomic activity, the grain trade, serving to export such surpluses as the land furnished by way of taxes, rents, and tithes.

The social organization of agricultural production cannot be characterized as having been capitalistic, and yet it was not feudal in the sense of being imbedded in an integrated local community. The non-peasant landlords, whether residing nearby or far away, typically limited their involvement in the productive process to a quite Mediterranean legalism. While no doubt preferring higher incomes to lower ones, they seemed intent on minimizing inputs of capital and of personal or paid management, relying on the passive owner's share of output, normally one-half. The "feudal" exaction, up to 1790, was confined almost exclusively to an all-encompassing and relatively heavy tithe.

The passive nature of landlord control translated itself into a preference for maximum wheat production, this being the commodity most easily marketed. Wine and garden or animal products beyond the direct needs of the landlord's household would have required investments that most were apparently loath to undertake. However, the landowning, surplus-collecting class did have an interest in abundant labour supplies that could keep wages low where hired labour was used, and assure a supply of diligent tenants with little required from the landlord by way of incentives or complementary inputs. By the first half of the XIXth century, abundant labour came to be taken as a matter of course, which made the subsequent change all the more unwelcome.

## II. Maize in the old agrarian system, 1750-1850.

In part because maize was never a glamour crop, its introduction and early diffusion in France are poorly known.<sup>4</sup> One source of confusion is in language. Maize in part replaced millet and was locally known by such names as *milloc*, *gros mil*, and the like.

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<sup>4</sup> In addition to the sources cited in footnote 3, I have drawn on R. CUSAC, *Origines de la culture du maïs en Gascogne*, Auch, 1952; D. FAUCHER, *La vie rurale vue par un géographe*, Toulouse, 1962; G. and G. FRÉCHE, *Les prix des grains, des vins, et des légumes à Toulouse, 1486-1868*, Paris, 1967; E. LEROY-LADURIE, *Les paysans de Languedoc*, Paris, 1966, esp. p. 71.

Also, maize was long thought to come from the East and, like another American food import, labelled "Turkish"; in Italy the name *grano turco* persists. There are traces of maize in France, even in markets, before 1600, but it appears to have become widespread around the turn of the XVIIIth century, apparently helped by the failure of other grain crops in such famine years as 1693-4 and 1709-10.<sup>5</sup> By the middle of the century, maize was an important crop in much of the Southwest. It also spread to the lowlands of Eastern France, notably along the Rhone, Saône, and Rhine rivers, but we shall concentrate on the Southwest, always the dominant maize-producing region. Even here, however, maize was a primary food grain in only a part of the region.

In order to situate maize in the agriculture of the region, we can usefully think in terms of a series of models, or systems, of agricultural production in which maize could find a place. These are stylized versions of traditional and more modern agricultural systems relevant to the Southwest of France, simplifications of a far more complex, and not always closely studied, agrarian history. The crop rotations especially, though they bring out essential features and limitations of each system, must be understood as highly schematic: actual practice varied sharply with location and soil quality, and was often irregular over time.<sup>6</sup>

a. the wheat/rye model: maize as the principal food grain

In certain relatively remote areas, valleys of the western Pyrénées or parts of the Landes, maize supplanted rye, wheat, or mazlin (*méteil*) which is mixed rye and wheat, becoming the basic food crop in a simple twofold rotation.<sup>7</sup> The principal advantage of maize was its enormously greater yield in the terms relevant to traditional agriculture: the ratio of crop to seed, as opposed to the modern standard of yield per unit of land. Whereas wheat yields in the somewhat backward Southwest ranged from five times seed (5:1) to 8:1, maize returned at least 25:1 and possibly as much

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<sup>5</sup> FRÊCHE, pp. 20-22.

<sup>6</sup> See A. ZINK, *Azereix*, Paris, 1969, p. 110; also BRUNET, p. 165.

<sup>7</sup> LERAT, pp. 448-456.

as 100:1.<sup>8</sup> In addition, maize benefitted from the late spring rains and hot dry summers typical of the extreme Southwest. However, we shall not further consider maize in this role.

b. the oats/barley model: maize as a spring grain

Once maize became established, it was most commonly grown in the context of the dominant French pattern of a threefold rotation centred on wheat (or rye). In fact, maize integrated the Southwest into an agricultural system suited to its climate and soils, but foreign to the culture of *Langue d'Oc* to which it belonged.<sup>9</sup> In the threefold rotation, the winter grain, e.g., wheat, stood in the lead position followed by a *mars* or spring grain and then, traditionally, by fallow (*jachère*). Not only did the climate favor maize over the more common oats or barley in the *mars* role, but the predominance of small over large animal husbandry made maize the more directly useful grain on the farm.

The process of diffusion of maize probably involved a stepwise transition, first from the simple twofold rotation to one including fallow (*jachère*). Not only did the climate favour maize over the These phases are shown in Figure 1 as A., B., and C. respectively. An important feature of all traditional rotations, preserved in sequence C. despite the apparent intensification, is the long interval between crops. This allowed time for the arduous task of soil preparation.

Adequate working of the soil, always the main task of the traditional agriculturist (hence called ploughman or *laboureur*), was especially important, as well as difficult, in the threefold agriculture of the Southwest with maize: important because maize requires a well-prepared soil, difficult because of inadequate tools and traction. In the absence of sufficient numbers of large animals, horses or oxen, the most common ploughing instrument remained the light Mediterranean *araire*, good for little more than scratching

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<sup>8</sup> For the lower estimate, see BRUNET, p. 333, and DUTIL, p. 146. The high figure is given in FAUCHER, *Le maïs en France*, "Annales de Géographie", XL, 1931, p. 114, and by ZINK, p. 189.

<sup>9</sup> DUTIL, p. 87.



the agricultural surplus taken off in the form of rent or tithe, or sold by tenants to meet their modest cash needs. As evidence, there are clear indications that the normal division of output, one-half to each party from all productions, was distorted in practice and even in contract. While the tenant could count on his full share of maize, various provisions of the leases, as well as the claims of other collectors of surplus, insured that he would get less of the wheat.<sup>10</sup> It has even been reported that maize did not figure in the tithe, suggesting that it was of no concern outside the farm itself; however, it appears that such was not the case, at least in those parts of the Southwest where maize was a significant field crop.<sup>11</sup>

Aside from the fact that wheat fetched a higher price than maize did, the arrangement was not illogical in terms of the system in force. Although both productions required, or at least received, more labour than they did other variable inputs, maize was particularly demanding in respect of work, requiring weeding and hoeing, and later shucking and shelling, as well as ploughing and harvesting. Tenant labour was considered costless by landlords, and presumably people would not stint themselves when it came to working on their own food supply. Importantly, much of the work involved in growing maize could be done either by auxiliary workers, women, children, the old, or in seasons other than the active periods of ploughing, sowing, and harvesting the wheat when all hands might be needed. Thus, the effective labour cost of maize was low, since wheat was more apt to require concentrated doses of work input and thus necessitate recourse to paid outside laborers. Cash outlays could only be envisaged for a cash crop. And there were other benefits to the landlord as well. If tenants worked the land well to obtain a bountiful maize crop, the subsequent planting of wheat

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<sup>10</sup> DUTIL, p. 142; BRUNET, p. 210. See also P. VIGUIER, *De colonage partiaire dans le Lauragais*, Paris, 1911, p. 105.

<sup>11</sup> For statements to the effect that maize was not tithed, see DEFFONTAINES, p. 225; FAUCHER, *La vie rurale*, p. 192; and CHOMBART DE LAUWE, p. 90. For the contrary view, see P. GOUBERT in *Conjoncture économique - structures sociales: Hommage à Ernest Labrousse*, Paris and The Hague, 1974 (hereafter *Mélanges Labrousse*), p. 379.

benefitted. And the green maize tops furnished fodder to the livestock during the dry months. Yet on both counts, the traditional system did things halfway. The wheat-maize-fallow crop sequence deprived wheat of the immediate benefits of good soil preparation for maize, while the cutting of green tops, though long touted as benefitting the yield of maize grain as well as providing forage, in fact hurt the ripening grain.<sup>12</sup>

In the above respects, the analogy between maize and the potato, as it was cultivated for example in Ireland, is a good one. Root crops performed an essential function in cool, wet climates of maintaining or restoring the ability of the soil to grow grain.<sup>13</sup> They were an alternative to grass or fallow, and thus intensified cropping. Feeding people as well as pigs, potatoes permitted a strong response in Ireland to the favorable demand conditions for grain in the last decades of the XVIIIth century and up to Waterloo.<sup>14</sup>

The analogy cannot, however, be carried the whole way. The reason is that potatoes did indeed, as the conventional wisdom has it, feed many more people than otherwise possible on a given amount of land, five times as many by Morineau's estimate.<sup>15</sup> Such was not the case with maize, although there is a good deal of confusion on this subject in the literature. Let us try to clear it up.

As we have noted, maize was indeed much more productive than wheat or other grains in the terms applicable to traditional agriculture, namely the ratio of crop to seed, the difference being at least fivefold. But writers have also reported that maize yielded "two to three times" as much as wheat on a per acre basis.<sup>16</sup> This is clearly an exaggeration if intended as any sort of norm or average. We have aggregate data only from the middle of the XIXth century, but there is no reason to believe that wheat cultivation, especially

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<sup>12</sup> This practice, called *écimage*, was still being decried in pamphlets published in the 1940s and 1950s. See, among others, PH. JUSSIAUX, *Le maïs*, Paris, 1952.

<sup>13</sup> A modern treatment that goes behind the direct demographic consequences of the potato is R. D. CROTTY, *Irish Agricultural Production*, Cork, 1966. See pp. 25-6.

<sup>14</sup> CROTTY, p. 28-31.

<sup>15</sup> MORINEAU, p. 1768.

<sup>16</sup> FORSTER, p. 62; also DEFFONTAINES, p. 225.

in maize-growing areas, had improved by then, and even less reason to suppose that maize yields declined in the early XIXth century. The 1840 data for France as a whole suggest a small difference in yields. In fact, maize yielded slightly less than wheat on a gross basis, but somewhat more net of seed.<sup>17</sup> The numbers are 9.2 quintals/hectare for wheat (7.7 qu/ha net) and 8.5 qu/ha (8.2 qu/ha net) for maize. For 1862, the data are disaggregated by department, and are given for a "good normal" year as well as for the survey or census year itself. On a gross basis, "normal" yields had risen to 12.0 qu/ha for wheat and 11.5 qu/ha for maize, an insignificantly more rapid rate of increase for the latter.

However, in the maize-growing areas themselves, relative yields favoured maize somewhat more. Again in 1862, in the six departments with the largest maize acreage, average gross yields (normal-year basis) were 12.1 qu/ha for maize as against only 10.5 qu/ha for wheat. Of course, the advantage was greater on a net basis, 11.8 qu/ha *versus* 9.0. At a maximum, therefore, the advantage enjoyed by maize was 30%, but this in turn overstates the case somewhat. First, maize is not so nutritious as wheat, being deficient in protein. Second, if one looks at the areas where wheat and maize were in relative balance, leaving out two departments where maize predominated, the gross yield ratio ranges from 0.9 to 1.2 (maize/wheat, departmental averages) and the net from 1.0 to 1.4. Finally, this time for the XVIIIth century itself, there is Zink's evidence for a single village. Her data give maize an edge of 60% over wheat on the best soils of the commune (21.4 qu/ha *versus* 13.4 qu/ha), but this must be seen as a high estimate, since she reports these same soils as yielding 96 times seed in maize cultivation, high in the range of those estimates.<sup>18</sup>

To sum up, then, maize yields were higher, on the average, than wheat yields in the same region, especially on a net-of-seed basis, but in all probability not more than half again as high.

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<sup>17</sup> The following numbers have been calculated from data in the decennial surveys, or censuses, of French agriculture, carried out in 1840, 1852, 1862, 1882, 1892, and 1929. MINISTÈRE D'AGRICULTURE, *Résultats généraux de l'enquête décennale de 1862* (etc.), (hereafter, *1862 Census of Agriculture*, etc.)

<sup>18</sup> ZINK, p. 189.

## Maize in French food: a digression

Maize is rather more conspicuous by its absence than by its presence in the food of France, particularly in the perceptions of Americans.<sup>19</sup> Although Jefferson's Paris garden yielded corn on the cob, and this mode of eating maize was mentioned in the *Larousse Ménager* of 1920, it has never taken hold.<sup>20</sup> Mature Frenchmen still recall the infamous *pain de maïs* of 1947, when bread rationing was aggravated, or offset, by bread of a quality many French found almost inedible. It was commonly believed at the time that the inclusion of maize flour in American aid supplies was due to a linguistic confusion, the French having requested "corn." C. P. Kindleberger has assured me that there is no truth to this story, simply that the demands of feeding most of Western Europe proved too much for American wheat surpluses in that critical (and, in Europe, climatically difficult) year.

But even for the Southwest, where maize was long an acknowledged staple food, its role has recently been called into question. J. Vedel is almost ready to relegate maize as a food staple to the status of a "legend", since, in the Toulouse region at least, its production in the XVIIIth century was much less than a quarter of the total cereal output: 8.6% in the Diocese as a whole, 28% in a single commune in the heart of the maize-growing area.<sup>21</sup> Part of the answer, no doubt, lies in the difference between gross and net production, more in the food crop/cash crop distinction. Peasants (here mostly tenants) received much less of the wheat than of the maize and had to sell wheat to pay taxes and meet other cash needs. On the other hand, maize was fed to animals whereas wheat was not.

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<sup>19</sup> Two paragraphs or so in W. ROOF, *The Food of France*, 1966 edition, New York, pp. 405-406 and 420-421.

<sup>20</sup> See Y. BIZARDEL, *The First Expatriates: Americans in Paris during the French Revolution*, New York, 1975, quoted in the *Wall Street Journal*, September 16, 1975; also A. CASTELLOT, *L'histoire à table*, Paris, 1972, p. 413, who says that corn on the cob is now the gastronomic fashion in France.

<sup>21</sup> J. VEDEL, *La consommation alimentaire dans le Haut-Languedoc aux XVIIe et XVIIIe siècles*, "Annales (E.S.C.)" XXX, no. 2-3, March-June 1975, p. 489. The data given are for 1713-1774. Note that in the same issue, p. 542, Dauphin and Pézerat assign maize a "considerable" role in the food of southwestern peasants a century later.

Whatever the extent of its use, maize was common in the Southwest, but it became an inferior food, by 1900 an end-of-the-week substitute for wheat as a base for bread.<sup>22</sup> Yet as early as 1757, an Intendant had urged the export of maize from Béarn to Spain, since the French would eat it only in time of penury.<sup>23</sup> Maize flour was used to make « various coarse rustic cakes and breads », but also in puddings, gruels, and dumplings, sweet or savory.<sup>24</sup>

It is possible, of course, that the slight notice taken of maize in writings about French food reflects only the plant's limited importance. However, the silence may also give a clue to some significant and underrated changes in rural France, during the second half of the XIXth century in particular. While the extent of agricultural progress has largely been estimated from increased deliveries of commodities to organized markets, urban as well as foreign, a good deal of it undoubtedly took the form of improved diets for the agricultural population itself. The substitution of wheaten bread for other basic sources of calories was part of a general process of qualitative betterment. And what we have come to think of as "traditional" French country food is, at least as regular fare, of quite recent vintage.<sup>25</sup> This sort of progress is assuredly underreported in statistical sources.

d. the sugar beet model: maize in revolutionary and modern agriculture

Maize and sugar beets are agronomically similar. Their economic history in France has, however, been markedly different

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<sup>22</sup> M. BIDAU, *Le maïs dans l'économie du Sud-Ouest de la France*, "Annales de la Faculté de Droit (Bordeaux)", Série Economique, II, no. 1, 1953, p. 3.

<sup>23</sup> O. PÉREZ, *La révolution agricole du XVIIIe siècle en Gascogne gersoise*, "Revue Géographique des Pyrénées et du Sud-Ouest", XV, 1944, p. 81. It may be assumed that the Intendant was referring to marketed surpluses of maize and to the tastes of town dwellers.

<sup>24</sup> The quote is from E. DAVID, *French Provincial Cooking*, Penguin Edition, 1969, p. 100.

<sup>25</sup> I have made this point in an earlier article, *Change in Rural France in the Process of Industrialization*, "Journal of Economic History", March 1972, pp. 241-261. Root does devote attention to the mushes, thick soups, and other homely staples of true traditional rustic French food.

until World War II, since when the stories have strongly converged. Today, one or the other is almost always found as one element in cereal rotations. As a rough guide, Paris and its immediate surroundings divide the maize-growing warmer regions from the cooler plains in which beets dominate.

Both beets and maize "clean" the soil, making it more suitable for grain crops. They require excellent soil preparation and weeding, consume large amounts of nutrients, and yield very well with proper care. Though the improvement they effect in soil condition makes both plants ideal complements of wheat, it would appear that they rival it in requiring large inputs of labour, animal or motorized traction, equipment, and fertilizer. Yet there are important elements of jointness. Much of the labour required for maize cultivation can be performed at times when wheat requires no work. More importantly, while wheat requires fertilizing, it benefits from having the soil enriched at some other point in the rotation, preferably soon before the wheat is planted. Direct planting of wheat in fertilized soil favours weed growth and increases the susceptibility of the stalks to beating down in wind and rain or hail.<sup>26</sup>

The differences between the two crops have also been important. The sugar beet has been a latecomer in France, later than maize in time, but also late in the sense of finding a place in a region of strongly capitalistic agriculture and industry, the northern half of the Paris Basin and up to the Belgian border. Indeed, the story of sugar-beet cultivation belongs more in the industrial than in the agricultural chapters of French economic history of the XIXth century. Many of the important issues that arise in debates about the pace and character of French industrialization are directly relevant to sugar beets.<sup>27</sup> After a false start under the shelter of the Continental System, real development began in the July Monarchy. Because of the ties between beet sugar and fiscal, commercial, and colonial policies, the government was always closely

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<sup>26</sup> L. THÉRON DE MONTAUGÉ, *L'agriculture et les classes rurales dans le pays toulousain depuis le milieu du XVIIIe siècle*, Paris, 1869, pp. 183-184 and 206.

<sup>27</sup> I have summarized some of the issues in *A Primer in the Economic History of Europe*, New York, 1968, pp. 124-131.

concerned. Yet little was provided by way of social overhead capital or technological infrastructure to encourage the industry. Even the simple, but crucial, step of shifting from a tax on sugar to one on beets, which led to rapid doubling of sugar content, required fifteen years of discussion. And the sugar industry, which maintained close links to the growers, tended to lag in the same areas of scale and technology that were weak points of other French industries. Finally, beet growers and observers of the industry were concerned above all with an adequate supply of labour, a particular problem in this region where both agriculture and industry flourished and yet to which few Frenchmen migrated. Much use came to be made of foreign workers.<sup>28</sup>

On the agricultural side, beets were from the start associated with revolutionary and modern agricultural practices, as we have defined these terms. Beets received heavy inputs of animal work and manure and in turn provided valuable fodder in the form of pulp, the residue from the sugar extraction process. A cash crop from the start, beets justified the use of purchased inputs, first of hired labour, later of machinery and fertilizers, even to conservative agriculturists. In any case, close linkages between growers and processors ensured that sugar beet cultivation would enjoy relatively good access to "knowledge" inputs. Maize, on the other hand, though inherently suited to the same place and methods in warmer regions of cereal culture, remained closely tied to the traditional agrarian system until well into the XXth century.

The essential difference between traditional and revolutionary agriculture is paradoxically contained in the apparently trivial distinction between rotations C. and D. in Figure 1. Both are threefold rotations, and both can accommodate various degrees of intensity in the use of land during the third year, from fallow

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<sup>28</sup> Some sources are G. DECOTTIGNIES, *La betterave et l'industrie sucrière dans l'Aisne de ses débuts à nos jours*, Paris (Law thesis), 1950; J. HÉLOT, *Le sucre de betterave en France de 1800 à 1900*, Cambrai, 1900; and J. REGNAULT, *Etude sur un prix de revient*, Paris (Law thesis), 1936. See also *Enquête sur la situation et les besoins de l'agriculture, 1866-1872*, 38 volumes, Paris, 1867-1872, 5ème Circonscription (hereafter *Enquête 1866*).

through grass crops to forage crops such as legumes. The crucial point is not whether fallow is eliminated or retained, the incidence of fallow having long ago become a function largely of the local, micro-conditions of soil and moisture. Rather, the two rotations embody different approaches to farming and soil fertility. In rotation C., wheat is clearly in the lead place, all other phases being subordinate to it. Crops exhaust the soil, which means that it must be rested, and the main crop should have the benefit of rested soil. Wheat also receives the benefit of any manuring or other soil improvements, as well as the most careful preparation. Finally, in the absence of large inputs of capital in the form of powerful implements and traction animals, spacing the crops allows good soil working prior to wheat sowing, another reason for fallow before wheat.

Contrast this approach with the one underlying rotation D., a "systems" approach to farming. The whole course is seen as a single process, all of whose operations, costs, and returns are equally significant because they are interdependent. The order of crops is determined by economic and agronomic logic rather than by some pecking order. In the case of a threefold rotation with maize, soil preparation is concentrated on the interval before maize planting and fertilizer is also added then. Not only does the maize yield benefit, maize being a demanding crop, but the soil is left in optimal condition for the wheat crop to follow. There is, to be sure, some cost: the light ploughing between the maize harvest and wheat sowing must be done quickly, and sometimes under the poor weather conditions typical of late autumn. Because quick work requires good equipment and powerful traction, there is further inducement to intensifying the rotation by including fodder crops and sown meadows in the place of fallow. In return, not only does the soil yield more abundant crops, but the long-run fertility of the soil is preserved. In the Southwest of France, the necessary commitment of increased inputs was largely absent, as was, apparently, the willingness to risk occasional delay in wheat planting for the sake of a productive, efficient, and viable system overall.

### Maize and population growth

We have examined the place of maize in the agriculture of the French Southwest from (roughly) 1750 to 1850 with the use of three simple models of traditional agriculture and one of revolutionary agriculture, the last relevant as a standard rather than as a description of actual practice. The argument has been made that maize helped reinforce the traditional system without doing anything to overcome its basic limitations. Maize did, as Langer argues, have some role in sustaining population growth within the Malthusian-Ricardian framework, but the nature and extent of that contribution must be examined more closely.

If one views the relation between population and food production as simply dependent on the degree to which the average or marginal product of labour exceeds the subsistence wage, then the contribution of maize was a modest one.<sup>29</sup> Fallow was reduced, very roughly from one-half to one-third. And the yield of land in maize cultivation was perhaps one-third again as high as in wheat. Together, these effects would add up to slightly more than a 50% increase in output for the portions of the Southwest where wheat-maize-fallow rotations were the rule.<sup>30</sup> Offsetting the increase is the fact that maize cultivation by traditional methods accelerated the process of soil exhaustion.

The full contribution of maize can be appreciated better with a somewhat more subtle model of the interaction between food production and population change. Given the importance of fluctuations in mortality in pre-industrial demography, the relevant model is a stochastic one in which annual or seasonal variations in food supply make shortage-induced, or shortage-aggravated, mortality peaks increasingly likely as population grows. Here maize contributed in two ways. First and foremost, weather-based fluctuations in maize yields tended to offset those of wheat, since early summer rains helped the former and hurt the latter,

<sup>29</sup> Marginal product for tenants, average product for landowning peasants.

<sup>30</sup> In six years, the relative outputs would be as follows:

twofold	100	0	100	0	100	0 =	300
threefold	100	133	0	100	133	0 =	466

while dry weather had the opposite effect.<sup>31</sup> Second, maize was harvested several months after wheat, at a time when grain prices were already rising toward their seasonal peak.

The evidence is, of course, spotty. In the aggregate, the population of the region rose steadily in the century before 1840, though the exact increase is not known. For the XVIIIth century Morineau puts the two *généralités* that include most of the maize-growing areas, those of Montauban and Auch, in the second-highest of five groups of French regions as regards population growth, with an increase estimated at 50-100%.<sup>32</sup> At the local level, there is the striking evidence of A. Zink for the single village she studies. A sharp increase in population, due precisely to a flattening of seasonal mortality rates by elimination of late-autumn peaks, takes place just during the years when maize cultivation becomes generalized (1750 to 1767).<sup>33</sup>

### Maize and attitudes toward agricultural change

Our previous discussion points strongly to the conclusion that the changes we have called agricultural revolution could well have been carried out in the Southwest of France before 1850 with maize playing an integral part. If, instead, maize found its place in the traditional system, giving it indeed added strength, perhaps a new lease on life, the reasons must be sought in the social, rather than in the technical, relations of production. Our object here is not to explain, in any sense, the existence of a passive landlord class and an impotent peasantry, but to examine their attitudes toward technological change and, specifically, toward the place of maize.

The study of attitudes is both important and difficult in this instance. Important because much of our total evidence is verbal and because we are concerned with unexploited technical possi-

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<sup>31</sup> P. VILAR in *Mélanges Labrousse*, p. 40; also GOUBERT, *idem*, p. 376, contrasting the region with the undiversified cereal areas such as the Beauvaisis.

<sup>32</sup> MORINEAU, p. 1771; see also BRUNET, pp. 364-365. It can be assumed that most of the increase, as elsewhere in France, came after 1730-1740.

<sup>33</sup> ZINK, pp. 115, 118.

bilities; difficult because the voices that have come down to us are a biased sample indeed. We hear landlords, some bureaucrats, publicists, local notables, and the like, almost never the peasants themselves. Primary sources are the official inquiries of the mid-XIXth century, as well as various reports, memoirs, and so forth, quoted in the literature, for earlier periods.<sup>34</sup>

The standard argument, most recently formulated by Langer, is that new crops, such as maize and potatoes, were the peasants' revolution, whereas enclosure and convertible husbandry were imposed from above.<sup>35</sup> The assumption is that peasants adopted new crops because they increased the food supply with little disruption of traditional structures and practices, and because they attracted little attention from landlords and tax collectors. In the case of France, there are indeed many statements to the effect that peasants favoured maize beyond reason and devoted their time to it to the detriment of care for the wheat crop.<sup>36</sup> However, it must be noted that when, after the middle of the XIXth century, peasants were in large measure freed from the dominance of outsiders in agricultural decision-making, maize rather lost their favour. As we shall see, its persistent strength then becomes something of an indicator of backwardness and slow change.

The attitudes of the elites themselves toward maize were ambivalent. In this region, the "aristocratic" interest in agronomy and agricultural improvement seldom went beyond the library or the *salon*. Maize was praised for ending (in fact diminishing) fallow, for freeing a larger fraction of the wheat crop for sale, and for sustaining a large population to work the land cheaply.<sup>37</sup> Yet many begrudged maize the labour, the soil nutrients, and even the

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<sup>34</sup> MINISTÈRE D'AGRICULTURE, *L'agriculture française par MM. les Inspecteurs Généraux de l'Agriculture*, Paris, 1840-1847, various departmental volumes (hereafter *Enquête 1840*); also *Enquête 1866*.

<sup>35</sup> LANGER, *op. cit.* Faucher earlier referred specifically to maize, the peasants' choice, by contrast with the "aristocrats' revolution" represented by intensive mixed husbandry; *La vie rurale*, p. 155.

<sup>36</sup> See for example in *Enquête 1866* voices (of the elite, of course) from the Landes (17ème circonscription), pp. 49, 392; also ARMENGAUD, p. 95.

<sup>37</sup> DUTIL, pp. 87, 142. Arthur Young is quoted in FAUCHER, *La vie rurale*, p. 152. See also DEFFONTAINES, p. 226; and *Enquête 1866*, Haute-Garonne (18ème circonscription), p. 218.

acreage it diverted from wheat production.<sup>38</sup> By the middle of the XIXth century, relatively sophisticated observers familiar with the system of convertible husbandry (revolutionary agriculture, in our terminology) held the view that maize made the old system workable and therefore retarded the adoption of forage crops and sown meadows. Yet this view, implicitly attributing retardation to the unadventurous peasantry, has little to commend it.

As we have noted, maize could, with proper inputs of knowledge and tangible capital, fit in very well with a system of intensive convertible husbandry. However, the only potential source of capital, the landlords, were reluctant to invest either financially or as managers in such a changeover, nor were they ready to modify contractual arrangements so as to provide the more substantial tenants with the incentive to undertake improvements themselves. Such supervision as was provided, and it could be close though often indirect, was largely concerned with preventing departures from accepted practices of good, i.e., traditional, husbandry.<sup>39</sup> The scarcity of capital was further aggravated by the bourgeois practice of buying land on credit, relying on the rents to pay off a mortgage.<sup>40</sup> But a dominant factor was the abundance of labor, due in part, of course, to the cultivation of maize. So long as tenants were plentiful, it was easier to reduce their share and change tenants frequently under a system of short leases. Although landlords benefitted from the high man/land ratio, they forgot the role of maize in insuring abundant labour and concentrated their attention on the ever-central maximization of wheat production.

The confusion inherent in elite comments about the causes of retardation is well brought out by looking at their specific observations regarding the place of maize in crop rotations, a matter to which we have given previous attention (see Figure 1). Some commentators pointed to the flaws in the traditional sequence, C. in our notation, in which wheat followed fallow. Others, how-

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<sup>38</sup> DUTIL, p. 142-143; *Enquête 1840* (Tarn), p. 245; THÉRON DE MONTAUGÉ, p. 13; FAUCHER, *La vie rurale*, p. 169.

<sup>39</sup> BRUNET, p. 211.

<sup>40</sup> *Enquête 1866* (18ème circonscription), p. 5; see also BRUNET, p. 354-5.

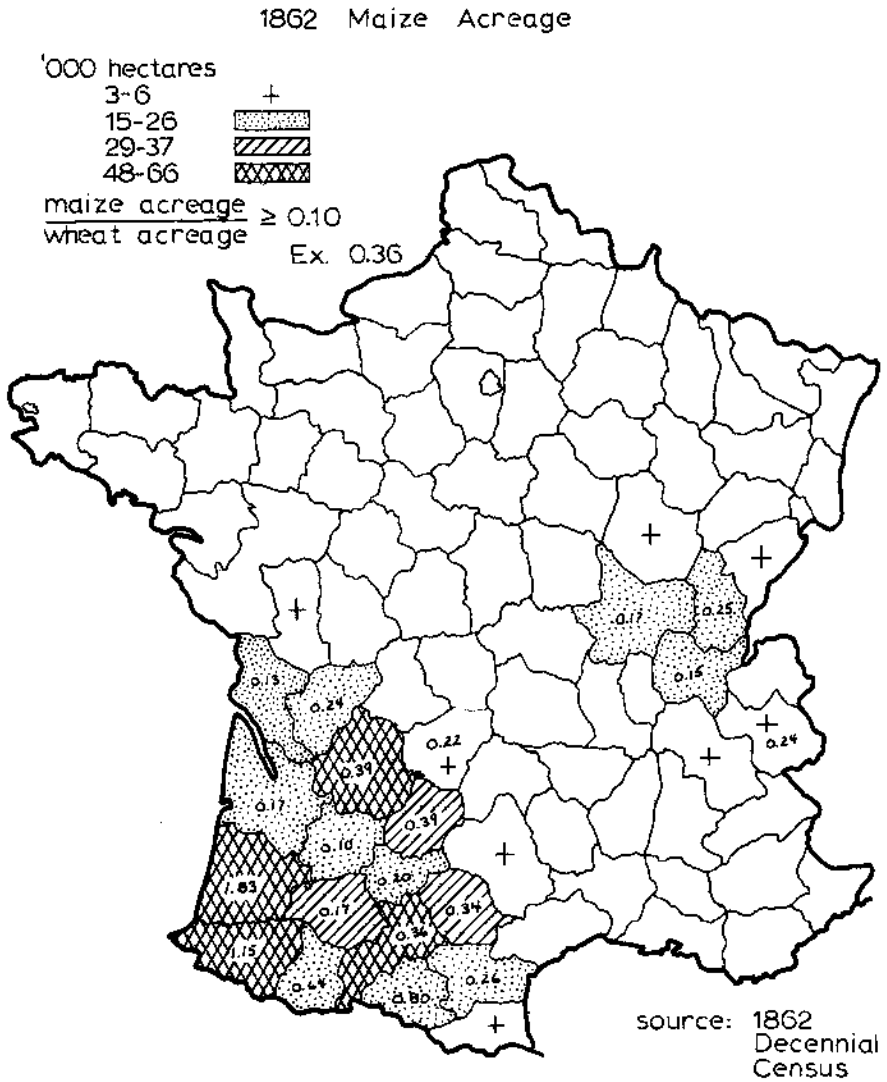


Figure 2

ever, focusing on the possibility of jeopardizing the all-important wheat crop, used the same adjective, "detestable", to refer to the D., or revolutionary, rotation.<sup>41</sup> Finally, some merely wrote off maize itself as a "scourge" of the region's agriculture.<sup>42</sup>

### Maize cultivation in the mid-XIXth century.

We can end this long discussion of the place of maize in the traditional system of agriculture of the French Southwest by summarizing the available quantitative information. Most of the data that follow refer to the survey year 1862, but there is evidence that little had changed in the agriculture of the region by that date.<sup>43</sup> Total maize acreage for France had fallen only 8% since 1840, the date of the first census, with some improvement in yield (from 8.5 qu/ha to 11.5 qu/ha, as previously noted). Figure 2 shows the scope of maize cultivation in the mid-century. The shading indicates the actual surfaces planted in each department, while the numbers show the ratio of maize to wheat acreage to indicate the place of maize in arable farming.<sup>44</sup> Only significant maize acreage (at least 3000 hectares) is shown, and the ratio to wheat is indicated only where it is at least 0.10.

The predominance of the Southwest is clearly shown on the map: Saône et-Loire, much the largest maize producer in the East, had only 23,200 ha in cultivation, only 17% of the acreage devoted to wheat. Maize yields ranged from 8.5 qu/ha to 16.1 qu/ha (departmental averages). Five departments accounted for 44% of acreage and output, another dozen for as much again. To put these numbers in perspective, for France as a whole about thirteen times as much wheat was produced in that year as maize, on

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<sup>41</sup> For critics of Rotation C., see *Enquête 1866*, Landes, p. 49 and Basses-Pyrénées, pp. 102, 159; also THIÉRON DE MONTAUGÉ, pp. 183-184. For critics of Rotation D., see *Enquête 1840* (Aude), p. 162; *Enquête 1866*, Landes, p. 49.

<sup>42</sup> ARMENGAUD, p. 105; also *Enquête 1840* (Aude), p. 194.

<sup>43</sup> Data from 1862 *Census of Agriculture*.

<sup>44</sup> The importance of maize in certain mountainous fringe areas of the Pyrénées and Massif Central is overstated by the use of wheat acreage alone in the denominator. The total area planted to wheat, rye, and maslin (*méteil*) would more accurately convey the amount of land used for basic food grain production in poor areas.

nearly thirteen times the acreage; and even in the big five maize growing départements eighty per cent more acres were devoted to wheat than to maize, and sixty per cent more of the former produced. Incidentally, our analysis of the static nature of South-western agriculture is reinforced if we note that the centres of maize cultivation were below the French average in wheat yields, despite comparatively good natural conditions.<sup>45</sup>

### *III. The eclipse of maize and of the Southwest: 1850-1950*

The dates of the present section are as approximate as those of the last part, despite nominally better statistics. It would be better to speak of mid-century to mid-century. In this period, however bounded, a muted Malthusian crisis clearly occurred. It led to a decline, gradual and yet substantial and lasting, in the population of the region, and to an eclipse in its economy, certainly relative to the growing and modernizing national economy. The cultivation of maize in the Southwest followed a parallel course, and the interplay between the general rural economy and maize sheds some light on the processes of change involved.

First, the question of timing. Brunet's magisterial work on the Toulouse sub-region posits a fairly sharp break in the 1840s, and then stabilization, or stagnation, of the rural economy until nearly the 1960s. But the data on maize, which are arguably relevant to the story, suggest a somewhat different chronology: a phase of gradual decline until the 1890s, then a sharp structural shift from 1890 to 1930 or so, finally a muted recovery in the 1930s leading into strong postwar improvement.

What was the mechanism at work? I put forward the following scheme, conscious of its excessive simplicity and dogma-

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<sup>45</sup> Wheat yields per unit of land are a good indicator of agricultural modernization in France. Not only do low yields bespeak inferior technology, they also suggest that agriculturists continue the traditional French practice of growing some wheat, usually for household consumption, even when soil and climate conditions are unsuitable.

tism.<sup>46</sup> In the first half of the XIXth century, the combination of growing population and little or no agricultural progress lowered the agricultural wage while maintaining rents high, tariffs on wheat helping. Around the mid-century, a number of developments connected with urban and industrial development led to a threefold current of emigration from the Southwest: of workers, particularly the landless, of elites seeking urban residence and opportunities to employ themselves and their capital to better advantage, and of jobs in non-agricultural pursuits. The result was a gradual change in the agrarian structure with greater independence of the peasants, often taking the form of tenants or labourers gradually acquiring their own holdings. The structural change was far more noteworthy than, and indeed worked against, technological change in agriculture. The initial decline of population, based in part, at least, on emigration, was prolonged and deepened by the low natural increase of landowning peasants. Agriculture became less, rather than more intensive, the one-time concentration on cereals giving way to a balanced polyculture that could pass for a pale copy of true convertible husbandry. Eventually, sustained demand for agricultural specialities, such as fruit and fowl, and easier access to external inputs and better transport brought gradual improvement within the existing mould. Perhaps most favourable was the simple fact that balanced polyculture and depopulation combined to maintain soil fertility.

Maize continued to play a part in this agriculture, but a decreasing one. It retained a place as a principal food grain in areas or pockets of slowest change, and might even benefit from the fact that landowning peasants could emphasize food crops at the expense of cash crops if they chose to. Maize was also valued as feed for the poultry and pigs sent to growing urban markets. But given the nature of change, in which improvements in per capita

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<sup>46</sup> See HOHENBERG, *Change in Rural France* and also *Migrations et fluctuations démographiques dans la France rurale, 1836-1901*, "Annales (E.S.C.)", XXIX, no. 2, March-April 1974, pp. 461-497. My interpretation is in basic agreement with, and draws heavily on, the works of Brunet and Lerat previously cited. The differences with Brunet are in the emphasis on emigration. BRUNET, pp. 381-414.

income resulted mostly from a falling denominator, maize was an inferior good with the wrong factor requirements: too much labour to produce a food grain cheaper and less desirable than wheat.

a. the problem of soil fertility.

The fundamental weakness of the traditional system was, as we have noted, its inability to restore nutrients taken out of the soil by repeated cereal crops. Fallow and thorough working of the soil could restore the physical properties of the soil, but not its chemical ones. The revolutionary solution was convertible husbandry, with more animals and fodder crops in the rotation; the modern solution relies instead on purchased fertilizer as well as machines and fuels. Neither was much applied in the French Southwest. One expedient, practiced in the western part of the region, was to cut vegetation on the heath (*lande*) such as ferns, gorse, and the like, for use as litter or mulch, or to burn such plants and use the ashes for fertilizer.<sup>47</sup> But population growth meant more land clearing, cutting into even this meagre source of soil nutrients. Moreover, the problem of soil fertility was a cumulative one, in that diminishing returns to land would drive off some of the population and make it impossible to continue labour-intensive soil working, worsening the problem further.

b. the threefold emigration

At the same time as the rural population was pressing on the productive capacity of the land, France was entering on a period of sustained, if not very rapid, urban and industrial development. While many factory and mining jobs were created, mostly in areas far from the Southwest, in the aggregate the openings in transport, construction, public and private services, and commerce, much more broadly distributed, undoubtedly outnumbered those directly associated with industrialization. A combination of push and

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<sup>47</sup> LERAT, p. 162; R. FOUET, *Polyculture de subsistance et polyculture de spéculation dans les coteaux de la Haute-Savoie*, "Revue Géographique des Pyrénées et du Sud-Ouest", XXII, no. 1, 1957, pp. 15-16. Waste land also provided rough pasture to offset in some measure the inadequate production of fodder crops, including sown meadows.

pull elements led to movement out of rural areas into urban ones, and away from the laggard regions toward more rapidly developing places. But the timing, extent, and shape of the migratory flow are hard to grasp with any precision and have given rise to considerable debate. In line with a long tradition, Brunet labels the "evaporation" of the population from the countryside of the countryside an "exodus". P. Ariès, on the other hand, spoke, of the "evaporation" of the population from the countryside of the Southwest at this time, meaning that population declined because the fertility of the peasant population was so low. My own work supports Ariès for the second half of the century, but leaves somewhat open the decades from 1840 to 1860.<sup>48</sup>

Part of the debate turns on timing, part on data, more on geography and interpretation. Departmental data, showing intercensal losses and gains from natural causes and migration, do not distinguish sub-departmental *pays* with diverging experience, as for example poor uplands versus rich valleys. Nor is it easy to tell whether rural migration was offset by urban growth. But interpretation is also crucial. If one takes as the norm zero natural increase and zero net migration, then population losses in the Southwest are indeed attributable to both factors. But if the norm is for rural areas to give of their large natural surpluses to towns, then one must be struck by the low rates both of emigration and of natural increase in the countryside. It must be noted that, except for Bordeaux and, for a time, Toulouse, as well as a few islands of industry in the eastern end of the region, Southwestern urban development was practically non-existent. And data for the period after 1860 make it quite clear that few people left the region entirely. In summary, such emigration as there was consisted of the landless and affected relatively peripheral districts with marginal soils. Many richer areas, particularly near the Garonne River, absorbed immigrants on balance, but lost population anyway due to striking natural deficits. The map in Figure 3 shows the census maxima for the departments of the Southwest. The Garonne is indicated by a heavy line.

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<sup>48</sup> See HOHENBERG, *Migrations*, and references there.



The loss of elites and of their capital is quite impossible to grasp quantitatively, and was certainly a gradual process. Even in the middle of the XXth century, and not counting new large holdings acquired by outsiders such as returning *colons* from North Africa, Brunet's survey clearly shows that non-resident landlords still had considerable property in the Toulouse area.<sup>49</sup> One must, however, use official data on land ownership with care. Much so called *propriété foraine*, land held by outsiders, actually consists of parcels rented by one peasant to another situated closer, or by emigrated siblings to the one remaining. In any case, most landlords had, as we have seen, played a passive role, so that their further loss of participation and contact meant at most the loss of possible benefit: change could not easily come without them, but their presence was no guarantee of change. The drift away was in part due to the attraction of other investment such as railroad shares, foreign bonds, and urban real estate, and in part to the deterioration of prices relative to wages after about 1860.<sup>50</sup> As the net product of the land diminished and urban pursuits commanded increased attention, supervision was relaxed, leading to further erosion of the landlord's take. Finally, it was often easiest to sell off the land, piecemeal, to ever-eager peasants, one's own tenants or smallholding neighbours.

At the same time as jobs became available in numbers in cities and industrial areas, they diminished in the countryside and in mountainous or wooded areas that had developed proto-industrial activities based on timber and water power. Even in the Southwest that is our concern, although there was little rural industry, many people had been employed in local transport and handicrafts as well as in services. As Collins has pointed out, the economic "simplification" of the countryside *worsened* the labour situation from the point of view of agriculturists dependent on hired labour,

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<sup>49</sup> BRUNET, pp. 268-289.

<sup>50</sup> Regarding investments, see C.-A. MICHALET, *Les placements des épargnants français de 1815 à nos jours*, Paris, 1968, pp. 108 ff. French wholesale prices topped out in 1836 and declined thereafter, whereas wages climbed steadily until 1880. See Statistique Générale de la France, *Annuaire Statistique 1966*, p. 373, and G. DUPEUX, *La société française, 1789-1970*, Paris, 1974, p. 147.

since they had previously had access to non-agricultural workers during seasonal peaks. Henceforth, labourers would have to be hired year-round if they were to be available at the harvest.<sup>51</sup>

c. The effects on agriculture in the Southwest

Change in the structure of property had little visible effect. Farm size and organization did not ordinarily change with ownership. Some large farms once worked directly with wage labour under a hired manager might be split up into conventional-size units for lease or eventual sale; and there was gradual consolidation of microfundia into "medium", in fact small, farms.<sup>52</sup>

In the short term, peasant owners would continue to stress marketable crops so as to pay off the mortgage, an onerous task in a time of generally falling grain prices.

In a later stage, the recovery of surplus would allow primary emphasis on production for own use with marketed surpluses a welcome addition. The farmer's main problem was now the enormous effort involved in operating a diversified farm with minimum recourse to outside labour.<sup>53</sup> Over time, the attention given grain production declined and so did the intensity of land use for cropping. Though there was little development of forage crops or sown meadows, pasture became more abundant and animals increased in the form of peasant polyculture. However rough and ready, the characteristic of revolutionary agriculture came to the Southwest in the form of peasant polyculture. However rough and ready the process, it resulted in an improvement in peasant diets and the development, over time, of numerous commercial "speculations", or marketed specialities: animal products such as poultry, calves,

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<sup>51</sup> E.J.T. COLLINS, *Labour Supply and Demand in European Agriculture*, in E.L. JONES and S.J. WOOLF, eds., *Agrarian Change and Economic Development*, London, 1969, pp. 61-94.

<sup>52</sup> LERAT, pp. 187-194.

<sup>53</sup> Faucher sees excessive work as an important "push" factor in rural emigration. While this may be true of recent times, our analysis suggests that it was rural emigration that increased farmers' work load by depriving them of peak-season labour. *La vie agricole*, pp. 159, 170. The question still remains why the peasants of the Southwest, lacking enough labor to use their land to the full, still went so far in the direction of limiting family size.

and pork, garden crops, and brandies, all of which found ready urban and export markets. This diversification was encouraged not only by the low price of wheat but also by recurring crises in the other basic commodity of the Midi, wine. It may be noted that in a system of partly commercial polyculture, the usual problem of trying to estimate farm consumption, and therefore total agricultural output, is aggravated by serious underreporting of food sold in small markets by the producers themselves.<sup>54</sup>

#### d. Changes in maize cultivation

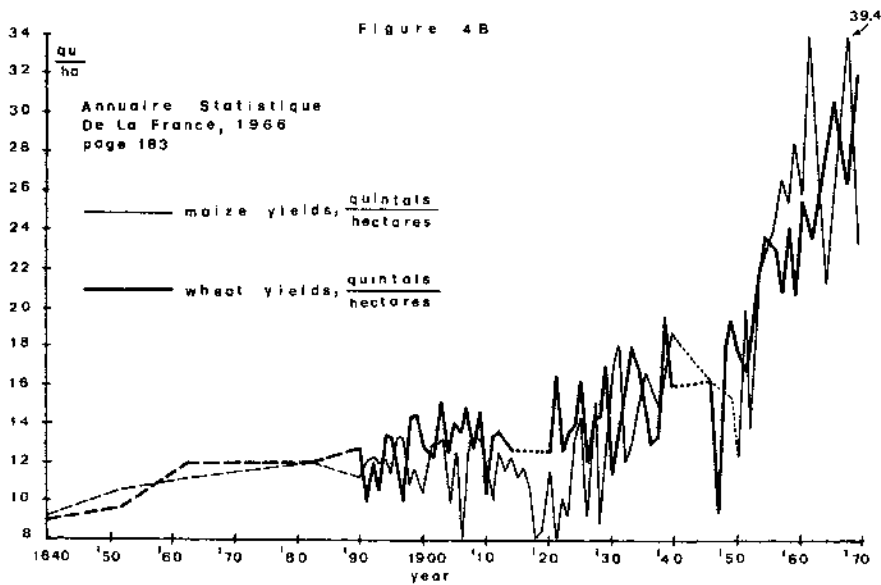
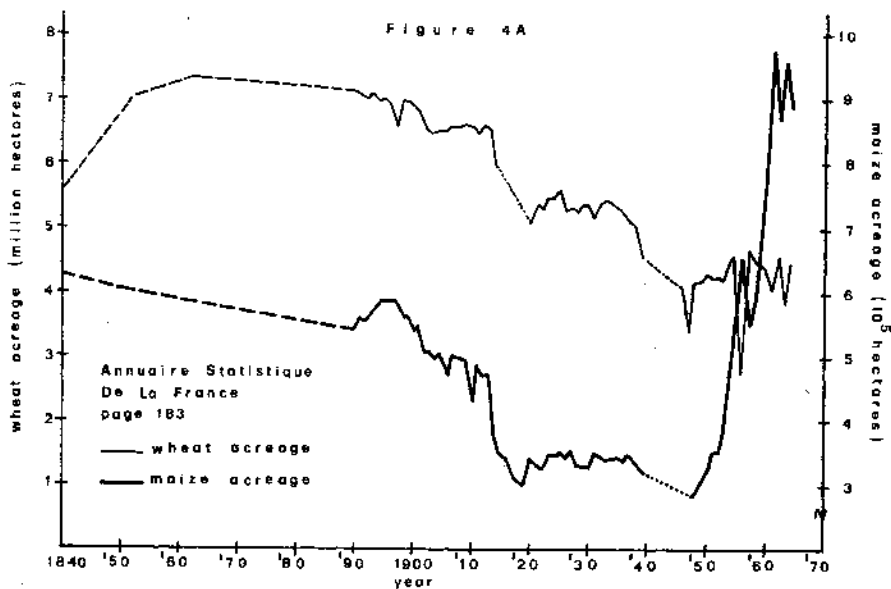
Slowly growing incomes, a reduced labour supply, a decline in sharecropping, less concentration on arable farming, all worked to erode the place of maize in the Southwest. The only new, or growing, source of demand came from regional exports of poultry and pork products, from Bayonne hams to the *foie gras* produced by force-feeding geese with maize. Yet even as French acreage and production declined, imports increased rapidly, surpassing domestic production during the interwar period.<sup>55</sup>

Figure 4 shows the evolution of maize cultivation and the yields for France as a whole, but reflects the situation in the dominant Southwest. Until the mid-1890s, the decline in acreage was gradual, and output was actually higher in 1892 than it had been in 1862, though off from the peak survey year of 1882. Then a steady decline set in that lasted until the outbreak of war, when acreage fell even more sharply. Although some land may have been diverted to wheat production to offset the losses in the North, it is likely that the decline in maize acreage was due to the loss of manpower, confirming the labour-intensive nature of this production. During the period of declining acreage, the gradual improvement in yields ceased, annual averages fluctuating markedly but without trend around the 12 qu/ha mark (about 21.5 bu/acre). During and after the war, yields even declined. In the interwar period, acreage

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<sup>54</sup> M. AUGÉ-LARIBÉ, *L'évolution de la France agricole*, Paris, 1912, p. 73.

<sup>55</sup> By 1929, French imports of maize exceeded domestic production by almost 60%, 820,000 tons vs. 520,000 tons. But 1928 had been a bad year for maize, causing 1929 imports to be 85,000 tons higher than the previous year. FAUCHER, *Le maïs en France*, p. 120.



stayed steady, but yields improved from the early and mid-twenties and continued to rise in the 1930s, possibly helped by the availability of nitrogen fertilizers from the ammonia works built in Toulouse during the war.

Looking at the data in cross-section, it may be seen that the relative decline in maize acreage was least where the crop had been most important; in general the maize-growing area seemed to shrink in on itself. The map in Figure 3 shows that peripheral departments as well as the East lost more of their 1862 acreage by 1929 than did the maize centres, with some exceptions. In addition to the three departments of the extreme southwest (maize acreage actually was higher in 1929 than in 1862 in the Landes), maize held up well in the two departments dominated by the Garonne valley, the Lot-et-Garonne and Tarn-et-Garonne, presumably because they were centres of more intensive and commercialized polyculture. On the other hand, in the plateaus around Toulouse maize retained importance in those areas where sharecropping also persisted, in other words in the most traditional and unchanging areas. By the 1950s, the spatial correlation there between sharecropping and maize cultivation was strong.<sup>56</sup>

Although the available data are not in a form easily amenable to statistical analysis, regression does tend to confirm the association between the earlier importance of maize (1862) and its retention in the XXth century (1929). For the 18 departments of the Southwest with significant maize plantings in 1862, the simple correlation coefficient between the retention of maize (1929 acreage as a fraction of 1862 acreage) and its initial importance (maize acreage as a fraction of wheat acreage in 1862) is 0.55. Adding an index of wheat yields in 1929 (1862 = 100) as a measure of agricultural progressiveness to the equation increases the coefficient of determination ( $R^2$ ) to 0.45, the regression being significant at the 2% level.<sup>57</sup> Of course, linear regression cannot capture the

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<sup>56</sup> See, in BRUNET, the maps on pp. 163 and 209. It must be noted that maize as a fodder crop, cut green, was cultivated in areas of more progressive mixed husbandry. See FOUET, *op. cit.* The present paper deals only with maize as a grain crop.

<sup>57</sup> See note 45.

mildly progressive role of maize as an input to commercial small-animal production.

In summary, the agricultural economy of the Southwest underwent a kind of unraveling, or negative development, between the mid-XIXth and mid-XXth centuries. Population fell and agriculture became less market-oriented, while towns stagnated and economic activity in the countryside lost much of its diversity. However, the retrogression in terms of division of labour did not prevent rising real incomes per capita and improvement in the ecological state of the countryside after a long period of grain exports on a scale unsustainable within the system of technology in use. For maize cultivation itself, while increased demand for feed might have compensated reduced human consumption, there was no technological progress to offset either soil exhaustion or, more importantly, the loss of the intensively used human factor of production. At least this was case until the mid-1920-s when, for reasons not yet established, the reduced surfaces began to yield steadily more.

#### *IV. The postwar maize boom*

After a wartime hiatus, the recovery in maize production begun in the thirties expanded into a full-fledged boom. Whereas 1930s planting of about 340,000 hectares had typically produced 500-600,000 tons for a yield of 16 qu/ha, the data for the first half of the 1960s show an average of 900,000 hectares devoted to the crop. With yields very nearly doubled, output quintupled.<sup>58</sup> By comparison, although French wheat yields also improved markedly over the period, the acreage devoted to wheat fell once more, to about two-thirds of the pre-World War I levels.<sup>59</sup>

Not only is more maize being planted, but its cultivation has spread to most of France. Whereas in 1929 only 31 of the 90 departments reported as much as 1,000 tons of grain produced,

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<sup>58</sup> The report of the President's Science Advisory Committee, *The World Food Problem*, Washington, 1967, gives U.S. maize yield as 39.3 qu./ha.

<sup>59</sup> 6.6 M ha in the early 1900s, 5.4 M ha in the interwar, 4.3 M ha around 1960. See Figure 4.

by 1965 only 8 departments were listed as non-producers.<sup>60</sup> And whereas in the earlier period (decennial surveys of 1862 to 1929) only three departments regularly reported producing more than 50,000 tons of maize, in 1965 about 25 departments reached that level. The Southwest remains the single largest centre of maize cultivation, particularly the traditional leaders: the Basses-Pyrénées (now Pyrénées-Atlantiques) and the Landes. But the plains outside Paris, especially the southern half of the basin, now strongly rival the Southwest, the more so as yields per unit of land are generally higher in the former.

Two changes are primarily responsible for the boom. One, quite well known, is the diffusion of hybrid maize, an American innovation that came to France after World War II.<sup>61</sup> The other is the definitive inclusion of maize in modern arable rotations in much the same role as sugar beets play in cooler regions. The two factors have interacted, since, as we shall see, hybrids require and reward the intensive, high-input cultivation of the modern system.

Hybrid maize requires purchased seed, careful soil preparation and cultivation, and large amounts of fertilizer and pesticides. In return, considerably higher yields can be obtained than with the varieties traditionally grown in France.<sup>62</sup> It was obvious that modern, large, highly capitalistic operations such as those of the Paris basin would readily adopt hybrids, and the growth of maize in the area is indeed closely tied to their introduction. But the diffusion of hybrid maize in the Southwest, with so many small, owner-worked farms only loosely involved in markets, posed considerably more problems.<sup>63</sup> The process has been closely studied

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<sup>60</sup> *Atlas économique et social pour l'aménagement du territoire*, Paris, 1967, Vol. II, Agriculture, no pagination.

<sup>61</sup> Z. GRILICHES' work on the diffusion of hybrid maize in the United States is a landmark in the economic analysis of technological change: *Hybrid Corn: An Exploration in the Economics of Technological Change*, "Econometrica", Oct. 1957.

<sup>62</sup> Although a doubling is not unheard of, the average improvement is from 30-80%. See Lerat, p. 302. For the United States, Griliches used an improvement in yield of 20%, but noted that no change in costs of cultivation was required. See Z. GLICHES, *Hybrid Corn and the Economics of Innovation*, "Science", 29 July 1960, pp. 275-280.

<sup>63</sup> With the decline of population on the plateaus of the Southwest, opportunities arose for quasi-colonial resettlement of certain areas. The new settlers were typically

both by geographers and by rural sociologists, and their findings provide a useful counterpoint to our examination of the dynamics of technical change and stagnation in earlier times.<sup>64</sup>

The small agriculturists of the Southwest, notably in the Béarn-Landes heartland, gradually switched over to hybrids during the decade of the 1950s, with a clear acceleration in the last years.<sup>65</sup> Those who hesitated did so in part for reasons of what we can call entrepreneurial failure, more or less artfully rationalized unwillingness to change; but they also had an accurate perception that the seemingly simple and straightforward substitution of improved seed for ordinary kernels was only the initial step in a series of far-reaching, ultimately systemic, changes. When they did make the change, it was not to get extra income but to forestall even more drastic attacks on their traditional agricultural enterprise.

The less rational objections to hybrids took many forms. Hybrids were denounced as an undesirable "American" innovation, adjudged less nutritious or the wrong colour for feeding poultry, or simply decried as less fine in appearance.<sup>66</sup> As regards process instead of product, farmers objected to the need for extra care and additional inputs, especially since they needed credit to finance the more expensive mode of production. And they feared the loss of independence they saw as a consequence of adopting hybrids: reliance on government experts, perhaps fresh out of school, on the cooperative, on government-set support prices. Most seriously, sceptical farmers would try out the new varieties more to confirm their scepticism than to help reach a decision, or else carry the experi-

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Europeans who had left North Africa. They assembled large holdings worked by modern, capital-intensive methods that departed totally from local customs and practices. See BRUNET, pp. 485-491. It may be added that as early as the 1920s, Italian and Spanish sharecroppers had taken over from departing locals. Perhaps their efforts account in part for the improvements in maize yield in the interwar period.

<sup>64</sup> BRUNET, pp. 590-597; LERAT, pp. 295-322; MENDRAS, *La fin des paysans*, Paris, 1970 edition, pp. 121-155.

<sup>65</sup> A historical parallel is worth recalling here. Just as the original adoption of maize is said to have been given strong impetus by the failure of other crops in 1693-4 and 1709-10, the adoption of hybrids received a boost when the drought of 1955 hurt the more shallow-rooted native varieties while the hybrids survived. See LERAT, p. 297.

<sup>66</sup> MENDRAS, *loc. cit.* Note that whereas Mendras says hybrids are white while local tradition demanded that fine poultry be fed with yellow grain, Lerat claims the opposite problem: MENDRAS, p. 125; LERAT, p. 300.

mental spirit so far as to cultivate the hybrid in the same way as native varieties, despite instructions to the contrary and with obviously poor results.

Despite all this, much of the reluctance reflected a more-or-less conscious understanding that adopting hybrids did not mean carrying on as before, only more profitably and productively. There was indeed some risk in incurring greater costs to produce a crop that might fail. The family farm, on which a living had been eked out with as few as twenty acres under the plough, was no longer big enough. The reason was that hybrid maize went hand in hand with mechanization, although it might well be true that a farmer adopted hybrids to use and help pay for a tractor already bought.<sup>67</sup> Furthermore, hybrids bound the farmer to the market. Fertilizer and fuel had to be paid for, and the tractor not only cost a lot, despite government help, but made the old farm implements obsolete. There was now more to sell, to be sure, but of fewer things. The security and satisfaction of supplying a variety of products was giving way to a style of farming reminiscent of older and less prosperous days.<sup>68</sup>

The rural sociologists tried to determine the different kinds of people who tended to be pioneers and laggards. Somewhat unexpectedly, perhaps, they found smaller and Catholic (meaning conservative) farmers more eager to adopt the new ways than those with larger holdings or who were to the left politically. The political difference they explained by pointing out that conservatives were less suspicious of the government, more outward looking, than their alienated, Communist-voting neighbours. The effect of farm size was not linear, larger landowners changing over quickly. But it suggested that among those with middling holdings, the ones with less land felt compelled to take action, whereas the possession of more land made it possible to get by with less technical sophistication.<sup>69</sup>

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<sup>67</sup> MENDRAS, pp. 130-131. Tractors were a fad in postwar France when there were few consumer goods to absorb high farm incomes. The purchase of a tractor also held sons on the land by giving them a sphere of expertise and some bargaining power with their employer and father.

<sup>68</sup> MENDRAS, pp. 132, 152.

<sup>69</sup> MENDRAS, p. 140.

We may conclude that the adoption of hybrid maize in the Southwest represented in large measure a defensive innovation. Two hundred years before, maize had provided a southern counterpart to the potato, and now it was complementing the sugar beets in the warmer areas of cereal cultivation. But whereas maize came to the defence of a technically backward and 'socially exploiting system of agriculture in the XVIIIth century, in the modern period hybrid maize was called on to save the region's family farms. The new crop yielded more output from limited holdings, justified a tractor to ease the work and "keep 'em down on the farm", and brought incomes during a period when the terms of trade were moving against farmers after the fat years. Yet again, it seemed as if the defensive innovation could only postpone, not permanently ward off, the crisis of a system. Just as soil exhaustion and population growth had caught up with the limited improvement originally afforded by maize, the family farm might well not survive the changes initiated by the adoption of the saving hybrids. With its larger cash need and narrower range of production, the farm is now at the mercy of agricultural price policies made far away, of inflation in fuel and fertilizer prices, as well as natural accidents. Even here, the parallel with the earlier case is striking. If things go badly, it is unlikely that ruin will result; rather, the young will again succumb to the lure of the city and leave.

#### V. Conclusion

In tracing the economic history of maize in France we have been led to use the term, adapted from A. Lamfalussy, of *defensive innovation*.<sup>70</sup> This is a change in technology intended to preserve a system of production in the face of natural, social, or purely economic forces that threaten its viability. Arithmetically of course, a loss averted is equivalent to a profit. In all other

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<sup>70</sup> The concept of "defensive investment" is defined in *Investment and Growth in Mature Economies*, London, 1961, Ch. 7.

ways they may be quite different. To seek additional profit from an investment or an innovation implies a discretionary decision requiring entrepreneurship in the sense of imagination and acceptance of risk. Defensive innovation, on the other hand, usually involves following the lead of others, or at least responding to a perceived necessity.

More is involved than the assumption that a unit of income is worth less the more of it we have. Under competition, losses imperil the existence of an enterprise unless its owner earns economic rent; true economic profits, however, are not only a luxury but probably a short-lived one. The adoption of maize, first in the XVIIIth century and again in the XXth in the form of hybrids, was largely a response of peasants pressed to survive on their holdings. In the first instance, they were seeking to protect their food supply against the claims of surplus receivers, the exhaustion of the soil, and the pressure of competing tenants. In the latter case, worsening terms of trade and the lure of an easier life off the land threatened the small, diversified, partly autarkic family farm. In both cases maize performed below its potential precisely because it was adopted as a substitute for thoroughgoing change rather than as an element of it. And in this instance at least, the benefit was not durable, the defensive innovation offering no escape from the inherent limitation of traditional agriculture.

A second theme of this study has been that behind apparently limited changes may lurk fundamental transformation of a system of production. Whereas the seemingly revolutionary introduction of maize served mostly to bolster the traditional agriculture of the French Southwest, albeit in a more advanced, "northern" variant, the real revolution in this region, delayed until our day, was contained in essence in a seemingly minor inversion of the order of crops in the rotation. In the older system, wheat took pride of place, all other productions being more or less "stolen" from the alternation between wheat and vivifying fallow. When, on the other hand, the cycle came to be viewed as a whole, a single agronomic and economic unit, it became logical to put a hoed crop, here maize, before wheat. The output of both was thereby increased,

and the way opened to more intensive husbandry with well-fertilized soil in continuous productive use.

Again in the recent period, the apparently small, or at least simple, substitution of hybrid for local varieties of maize carried with it the potential for transforming the system of polyculture that had grown up over a century. If only because maize output was much higher, and the labour available to the enterprise limited, it was no longer feasible to use maize chiefly to feed animals, as an intermediary product. It had to be sold, if only to pay for the many purchased inputs now required.<sup>71</sup>

A final conclusion that emerges is also somewhat in the nature of a paradox. It is a sort of cliché that economic development implies greater division of labour, closer integration with the market. Our story does not quite fit this textbook scheme. Commercialization may indeed be the sign of greater productivity (or its price, as we have seen), but it may simply reflect a system of social relations of production in which considerable surplus is extracted for use elsewhere. The economic history of Southern and Eastern Europe, to say nothing of colonial areas, affords many examples of commercial development unaccompanied by technological progress, rising incomes, or true development in any form. In the French Southwest of the mid-XXth century, a pseudo-capitalistic system gave way, in part and over time, to a seemingly more backward regime of semi-autarkic polyculture. Though technologically no more advanced than its predecessor, and showing many signs of neglect and stagnation, the new system did provide better living conditions for the working population, admittedly in decreasing numbers. It also furnished high-quality specialty products to growing urban markets that increasingly drew their basic food commodities from a limited range of regions of capitalistic farming and from abroad. Finally, if the system of peasant polyculture lacked technical sophistication, it was at least ecologically sounder than its predecessor, better balanced between arable and pasture.

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<sup>71</sup> The complications that arise in developing countries in the wake of the Green Revolution reinforce the point. See, for example, C.R. WHARTON, JR., *The Green Revolution: Cornucopia or Pandora's Box?*, "Foreign Affairs", IV, no. 26, 1969, pp. 464-476.

